BAYTRON SYSTEMS CORP.
3303 B-7 Harbor Blvd.
Costa Mesa, Calif. 92626
(714) 557-1682

MODEL 6040A

Preset EPUT® & Timer

(PREFIX 500)

SERIAL NO. 151

Beckman®

INSTRUMENTS, INC.

ELECTRONIC INSTRUMENTS DIVISION

SEPTEMBER 1967

Beckman® INSTRUMENTS, INC.

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(b) All instruments claimed defective must be returned to the Company, transportation charges prepaid, and will be returned to the customer with the transportation charges collect, unless the item is found to be defective in which case the Company will pay all transportation charges.

(c) The Company makes no warranty concerning components or accessories not manufactured by it, such as tubes, fuses, batteries, etc. However, in the event of the failure of any component or accessory not manufactured by the Company, the Company will give reasonable assistance to the purchaser in obtaining from the respective manufacturer whatever adjustment is reasonable in the light of the manufacturer's own warranty.

(d) Except as stated above, the Company makes no warranty, express or implied (either in fact or by operation of law), statutory or otherwise; and, except to the extent stated above, the Company shall have no liability under any warranty, express or implied (either in fact or by operation of law), statutory or otherwise.

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(g) This warranty shall be governed by the laws of the State of California.

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Experienced service personnel and special test equipment are available at any of three Regional Service Centers and the factory to perform any necessary repairs. Every effort will be made to expedite the repair of instruments returned for servicing. To obtain warranty service contact your nearest Beckman Service Office, which will give you the necessary instructions for returning the instrument. Beckman Service Offices now in operation are shown on the bottom of this sheet. Instruments returned for service will be sent to the Beckman Service Office, transportation charges prepaid. The instrument will be returned to the purchaser with transportation charges prepaid.

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DA Option

Model 6040A Block Diagram (D435029-Rev. A)

Models 6020A & 6030A Instruction Manual

DESCRIPTION

Beckman Model 6040A is a standard Beckman Model 6020A Preset EPUT® which has been modified as follows:

1) The inputs have been moved from the rear panel to the front panel.

2) An attenuator with X1, open, and X10 positions has been added to the front panel along with input triggering pots.

3) Slope selection of the amplifiers is controlled by front panel toggle switches.

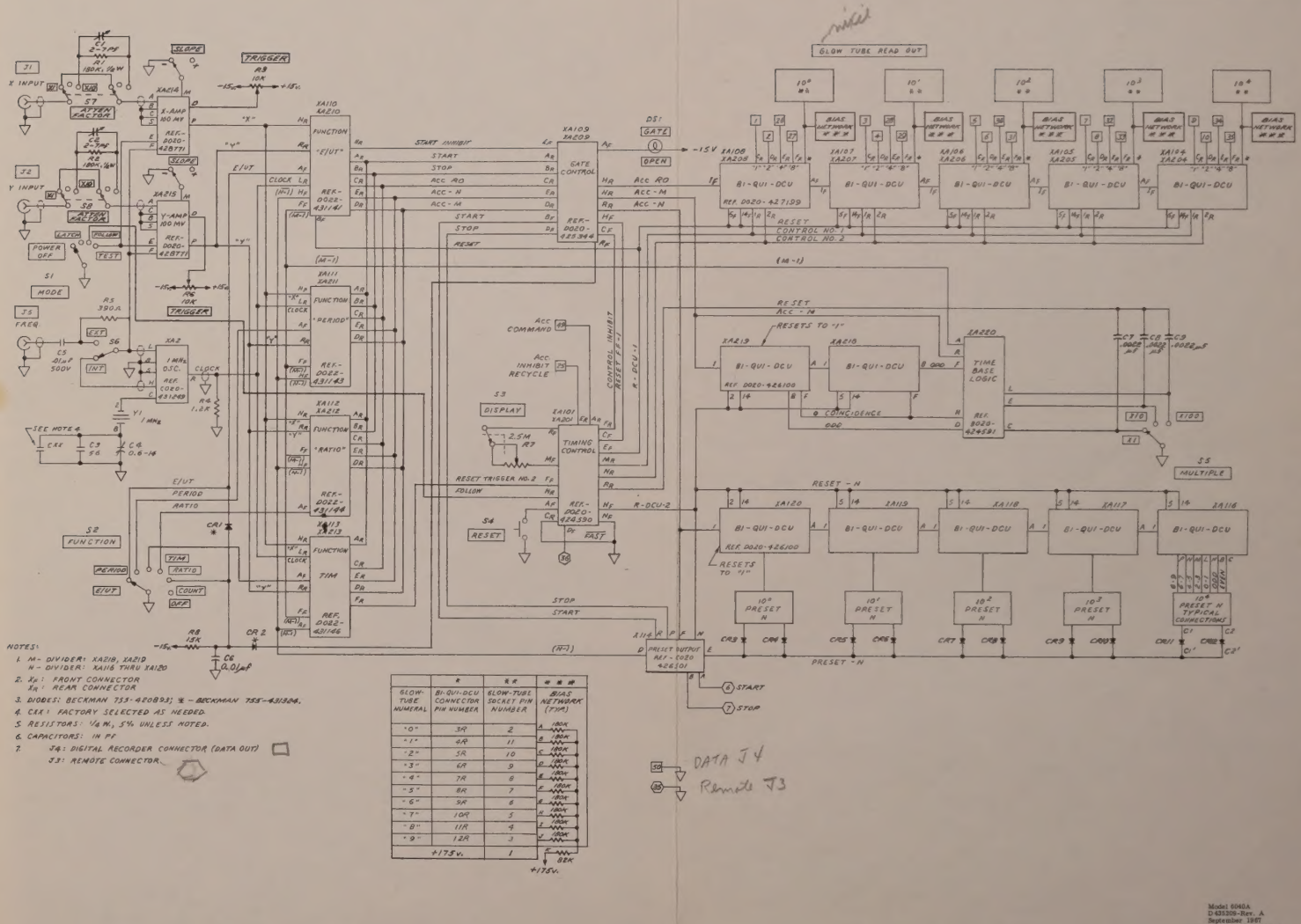
4) The N preset thumbwheel switches have been moved on the front panel to a central position.

5) The MODE switch has a LATCH and a FOLLOW position. In the LATCH mode the readout will update at the end of each cycle, while in the FOLLOW mode continuous updating is taking place throughout the cycle. The COUNT function should be used in the FOLLOW mode if the readout is to be updated by each count.

7) The DA (1 MHz oscillator) and DQ (tilt foot handles) options are standard equipment.

In all other respects this instrument is standard and the following instruction manual will apply.

MODEL 6040A
BLOCK DIAGRAM



NOTES:
1. M - DIVIDER: XA21B, XA21D
   N - DIVIDER: XA116 THRU XA120
2. X_F: FRONT CONNECTOR
   X_R: REAR CONNECTOR
3. DIODES: BECKMAN 733-420893; ⅜ - BECKMAN 755-431348.
4. CRX: FACTORY SELECTED AS NEEDED.
5. RESISTORS: ⅛ W, 5% UNLESS NOTED.
6. CAPACITORS: IN MF
7. J4: DIGITAL RECORDER CONNECTOR (DATA OUT)
   J3: REMOTE CONNECTOR

*	**	***
GLOW-TUBE NUMERAL	BI-QUI-DCU CONNECTOR PIN NUMBER	GLOW-TUBE SOCKET PIN NUMBER	BIAS NETWORK (TYP.)
"0"	3R	2	A 100K
"1"	4R	11	B 100K
"2"	5R	10	C 100K
"3"	6R	9	D 100K
"4"	7R	8	E 100K
"5"	8R	7	F 100K
"6"	9R	6	K 100K
"7"	10R	5	H 100K
"8"	11R	4	J 100K
"9"	12R	3	L 100K
+175v.		1	C 8.2K +175v.

Model 6040A
D 435309-Rev. A
September 1967

Beckman

CONTENTS

DA OPTION

TEXT

PARTS LIST

DIAGRAMS:

Crystal and Oven Assembly	B 430340
1 MHz Oscillator Board Component Layout	C 431247
1 MHz Oscillator Schematic Diagram	C 431248

DA OPTION

One-Megahertz Oscillator

GENERAL

The DA option equips Models 6020A and 6030A EPUT® Meters with a 1 MHz precision oven-controlled crystal oscillator (in place of the 100 KHz oscillator supplied as standard with these instruments). This higher standard frequency allows period and time interval measurements to be made with one-microsecond resolution and frequency measurements with shorter gate times. Also, since the oscillator has a low drift rate, the instrument may be used as a secondary standard for other measurements. It should be noted that the crystal oven is energized when the power cord is connected regardless of whether the instrument is on or off. To achieve maximum frequency stability, the instrument should be left connected to a live ac source.

SPECIFICATIONS

Frequency Output (at "FREQ" connector on rear panel)	1MHz at 2v peak-to-peak, min.
Long Term Drift	1.5 parts in 10^7 per week.
Temperature Coefficient	3 parts in 10^9 per ^{o}C from $-30^{o}C$ to $+65^{o}C$.
Line Voltage Coefficient	± 5 parts in 10^8 for a $\pm 10\%$ change in line voltage from 117v rms.

OPERATION

The basic instrument functions are changed in only one respect. The basic timing increment is 1-microsecond (instead of 10-microseconds). Consequently, the events and times for the functions are as follows:

a) EPUT

The count interval (gate time) is $N \cdot M \cdot 1$ microsecond (e.g., if N is set to 32 and M to 100, the count interval is 3200-microseconds = 3.2-milliseconds). If $N \cdot M = 10^6$ (e.g., N = 10,000 and M = 100), the readout will display the input frequency in Hertz. In general, the frequency of the input signal is obtained by dividing the readout by $N \cdot M \cdot 10^{-6}$.

b) PERIOD

The standard frequency counted is 1MHz (as opposed to the 100KHz counted frequency in the standard instrument). Thus the readout displays period or multiple period in microseconds. The number of periods measured is given by $N \cdot M$. The average period in seconds is found by dividing the readout by $N \cdot M \cdot 10^6$.

c) COUNT (Model 6020A Only)

This function is unaffected.

d) RATIO

This function is unaffected.

e) TIM (Model 6030A Only)

The interval between events at the X and Y inputs is displayed in units of $N \cdot M$ microseconds (instead of $N \cdot M \cdot 10$ microseconds as in the standard instrument). The time interval in seconds may be obtained by multiplying the readout by $N \cdot M \cdot 10^{-6}$.

f) STD. FREQUENCY INPUT (J5)

As in the standard instrument, any external frequency in the range 10KHz to 1MHz and amplitude 3 volts peak-to-peak may be used in place of the 1MHz oscillator by connecting it to the FREQ jack J5 and setting the INT-EXT switch to EXT.

CIRCUITRY

Refer to the 1MHz Oscillator Schematic Diagram (dwg. no. C431248), and 1MHz Oscillator Board Component Layout (dwg. no. C431247). For the electrical components contained in this assembly refer to the parts list.

SERVICING

To adjust the frequency, follow this procedure:

1) Connect the frequency output (J5) to the X axis of a suitable oscilloscope.

2) Connect a 1 MHz standard frequency from a suitable secondary standard (or better) to the Y axis of the oscilloscope.

3) Adjust the tuning capacitor (available through hole in rear panel marked FREQUENCY ADJUST) to achieve as stable as possible a 1:1 Lissajous pattern on the oscilloscope.

(C431247-A)

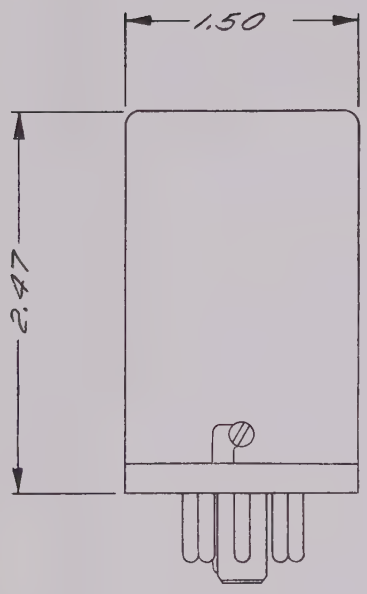
Parts List
One-Megahertz Oscillator

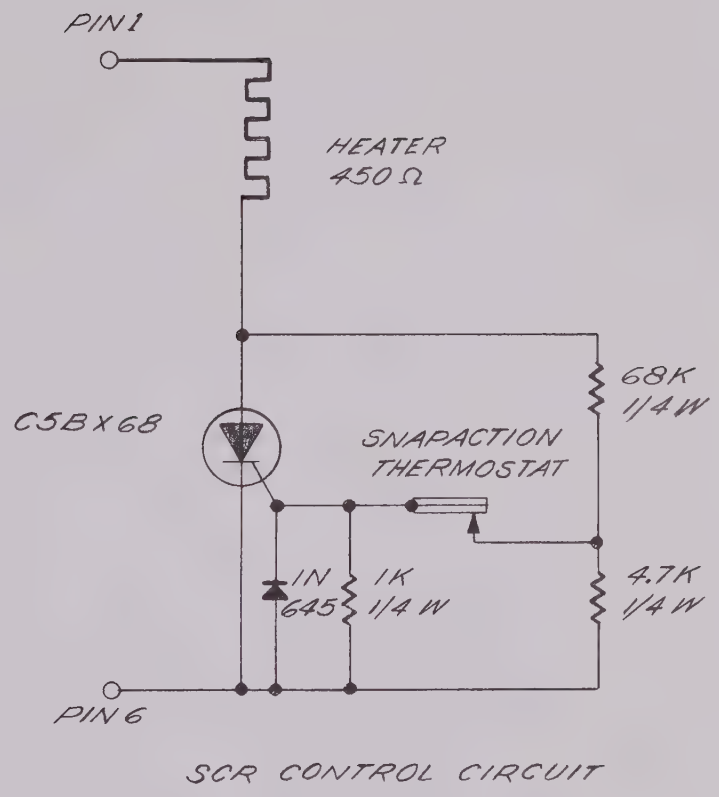
Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty./ Assy.
C1	633-804715	Capacitor, F., Cerm., 0.01μf, 50V	Sprague 19C214	6
C2	637-819381	Capacitor, F., Mica, 560pf, 300V, 5%	Elmenco SCDM15F561-300V	3
C3		Same as C2		
C4 thru C7		Same as C1		
C8	631-814054	Capacitor, Elect., 22μf, 35V, 20%	Sprague 150D226X-0035R2	2
C9		Same as C8		
C10		Same as C1		
C11	637-824498	Capacitor, F., Mica, 150pf, 300V, 5%	Elmenco DM15F151J-300	1
C12		Same as C2		
CR1	755-809734	Diode, Type 1N758	Cont. Device	1
CR2	755-402107	Diode, Special	Beckman	1
L1	795-827337	Inductor, 6.8μh, 5%	Nat'l NB-6.81	1
Q1	755-419596	Transistor, Special	Beckman	3
Q2 & Q3		Same as Q1		
Q4	755-817811	Transistor, Type 2N961	Motorola	2
Q5		Same as Q4		
Q6	755-823113	Transistor, Type 2N2219	Motorola	1
R1	601-822299	Resistor, F., Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	2
R2	601-823395	Resistor, F., Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	2
R3	601-823912	Resistor, F., Comp., 470K, 1/4W, 5%	Allen Bradley CB4745	1
R4		Same as R1		
R5	601-822328	Resistor, F., Comp., 2.2K, 1/4W, 5%	Allen Bradley CB2225	2
R6	601-822324	Resistor, F., Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	1

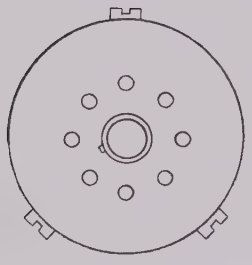
Parts List

One-Megahertz Oscillator - continued

Detail No.	Beckman Stock No.	Description	Typical Manufacturer & No.	Qty As
R7	601-823397	Resistor, F., Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	
R8		Same as R5		
R9	601-823388	Resistor, F., Comp., 56Ω, 1/4W, 5%	Allen Bradley CB5605	
R10	601-822544	Resistor, F., Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	
R11	601-823384	Resistor, F., Comp., 27Ω, 1/4W, 5%	Allen Bradley CB2705	
R12		Same as R2		
R13	601-801803	Resistor, F., Comp., 12K, 1/4W, 5%	Allen Bradley CB1235	
R14	601-822308	Resistor, F., Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	
R15		Same as R10		
R16	601-822327	Resistor, F., Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	
R17	601-822306	Resistor, F., Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	
R18	601-817735	Resistor, F., Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	
R19	601-822295	Resistor, F., Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	
R20	601-822326	Resistor, F., Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	
R21 thru R23		Same as R17		



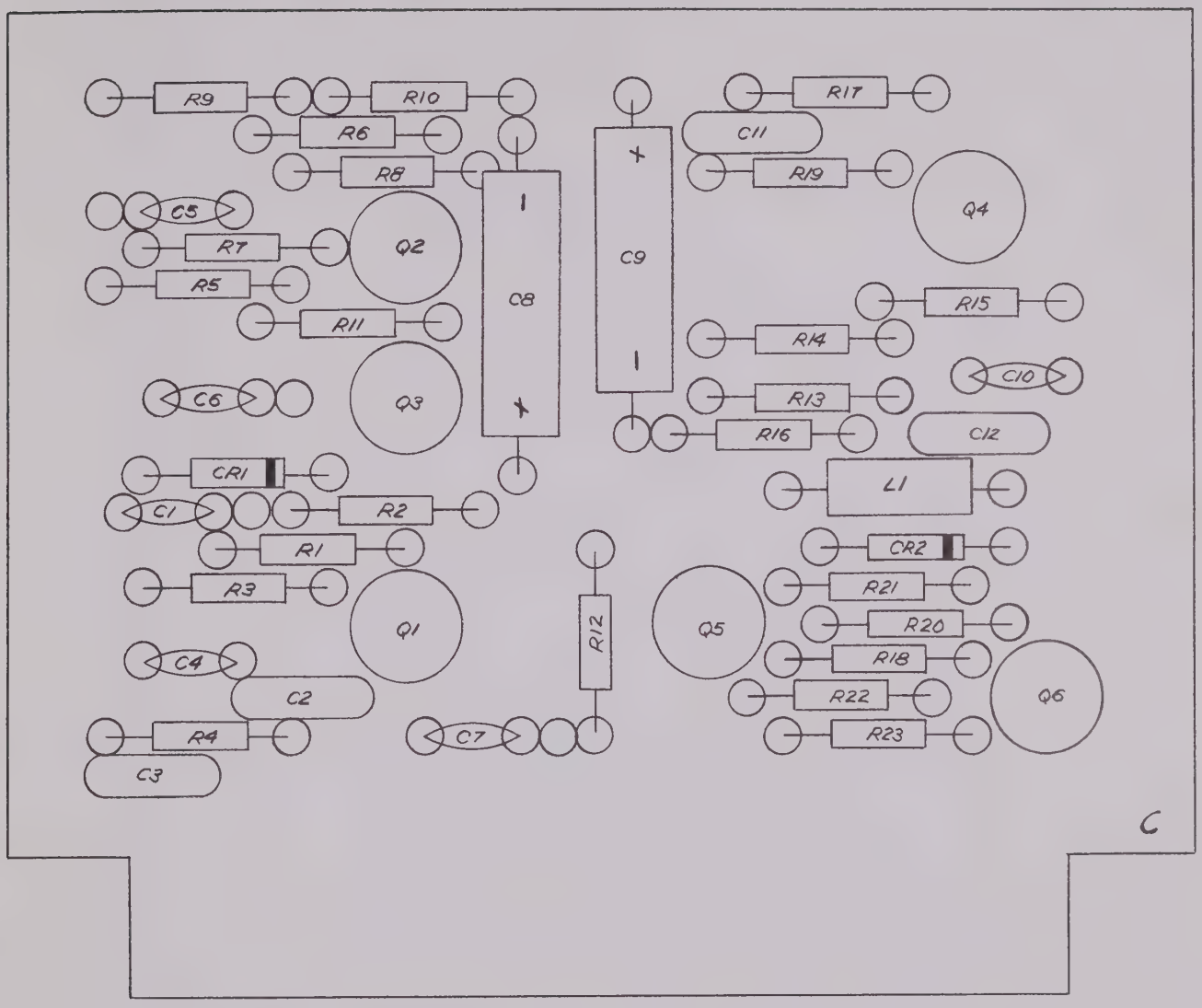




CRYSTAL AND OVEN ASSEMBLY

DA Option - 6000 Series
B 430340-Rev. B
October 1966

Beckman

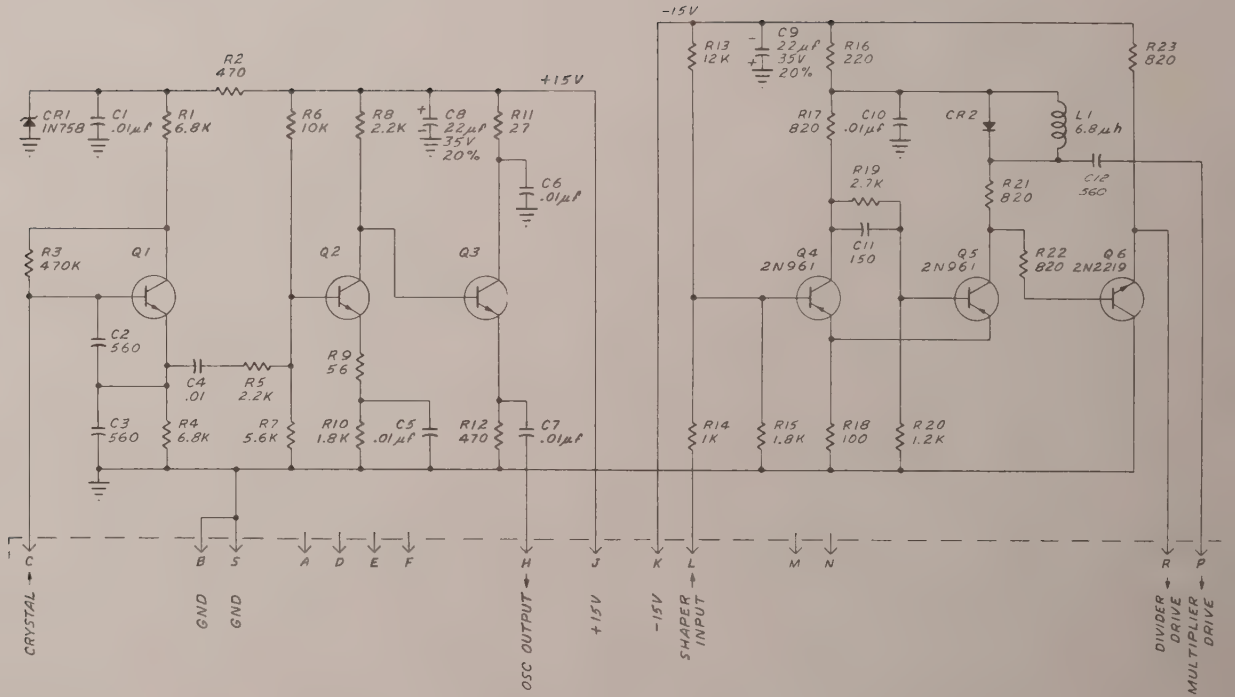


1 MH_Z OSCILLATOR BOARD COMPONENT LAYOUT

DA Option - 6000 Series
C 431247 - Rev. A
October 1966

Beckman

1 MHz OSCILLATOR
SCHEMATIC DIAGRAM



NOTE:

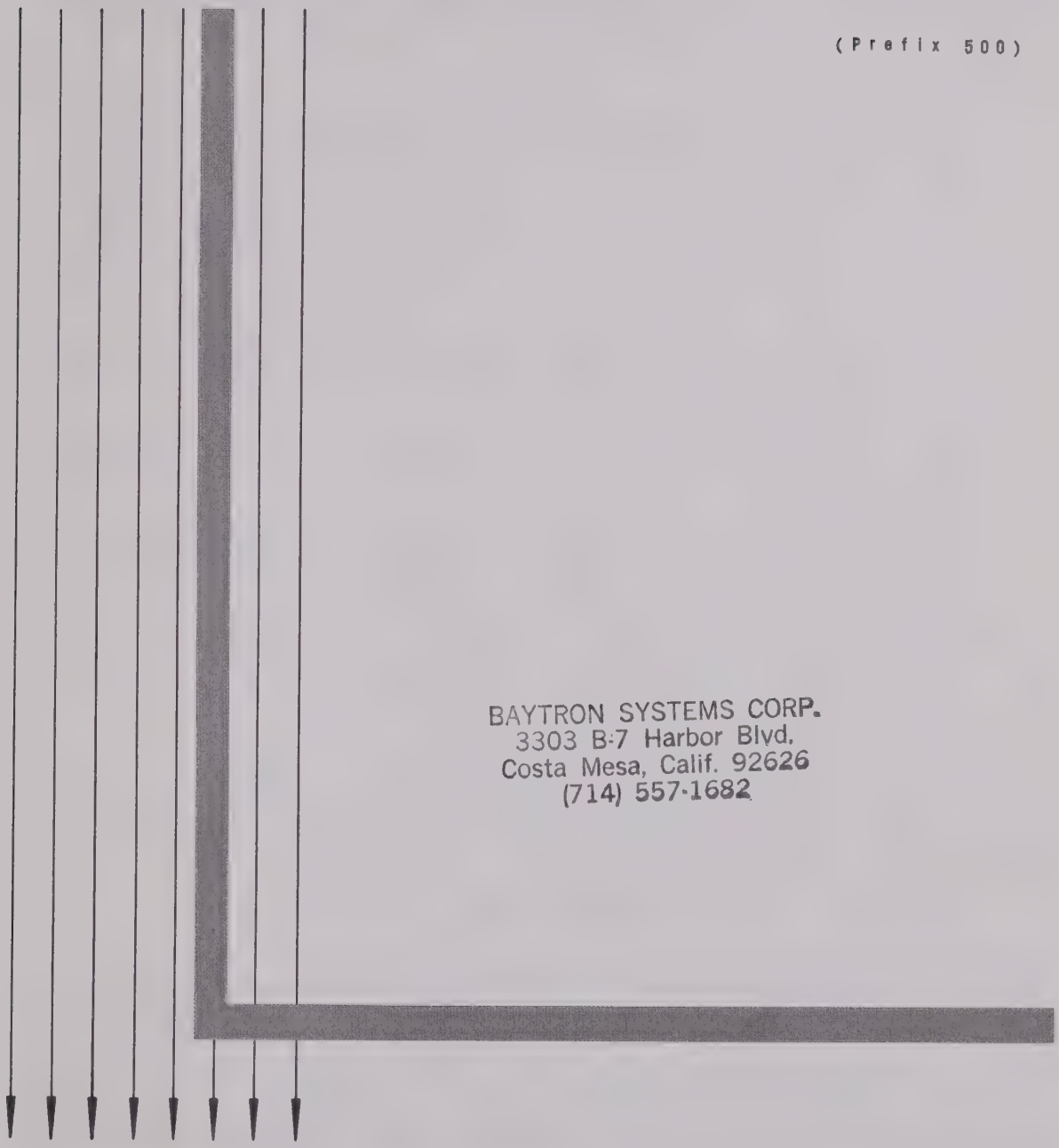
1. RESISTORS ARE 1/4W., 5% EXCEPT AS NOTED.
2. CAPACITOR VALUES IN PF EXCEPT AS NOTED.
3. DIODES ARE PER BECKMAN SPEC A755-402107 EXCEPT AS NOTED.
4. TRANSISTORS ARE PER BECKMAN SPEC A755-419596 EXCEPT AS NOTED.

DA Option - 5000 Series
C-81248 - Rev A
Oct-Dec 1966
Beckman

INSTRUCTION MANUAL

MODELS
6020A & 6030A
PRESET EPUT®

(Prefix 500)



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April 1967

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ELECTRONIC INSTRUMENTS DIVISION
RICHMOND, CALIFORNIA • 94804

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MODEL 6020 INSTRUCTION MANUAL
(Sections 1 through 4)

SECTION 5 PARTS LISTS and DRAWINGS

NOTE

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Logic Symbols and Typical Circuits

Options

DESCRIPTION

GENERAL

Except as noted in the following paragraphs, all information in the Model 6020 instruction manual applies to the Models 6020A/6030A instruction manuals.

INTRODUCTION

The five-digit, front-panel, edge-lit display has been replaced by a group of five numerical glow-tube indicators (see figure 1). Table 1 gives the specifications of these glow-tubes.

Table 1. Glow-Tube Specifications

Type	B5991 Ultra Long Life Rectangular
Absolute Ratings	
Ionization Voltage (Max)	170Vdc
Supply Voltage (Min)	170Vdc
Cathode Current (Peak)	3.5 ma
Test Conditions	
Supply Voltage	180Vdc
Series Resistor	8.2KΩ
Cathode Current (Min)	1.5 ma
(Max)	3.0 ma

PIN CONNECTIONS	
Pin No.	Characters
1	Anode
2	Numeral 0
3	Numeral 9
4	Numeral 8
5	Numeral 7
6	Numeral 6
7	Numeral 5
8	Numeral 4
9	Numeral 3
10	Numeral 2
11	Numeral 1
12	Internal Connection
13	Internal Connection
14	Internal Connection

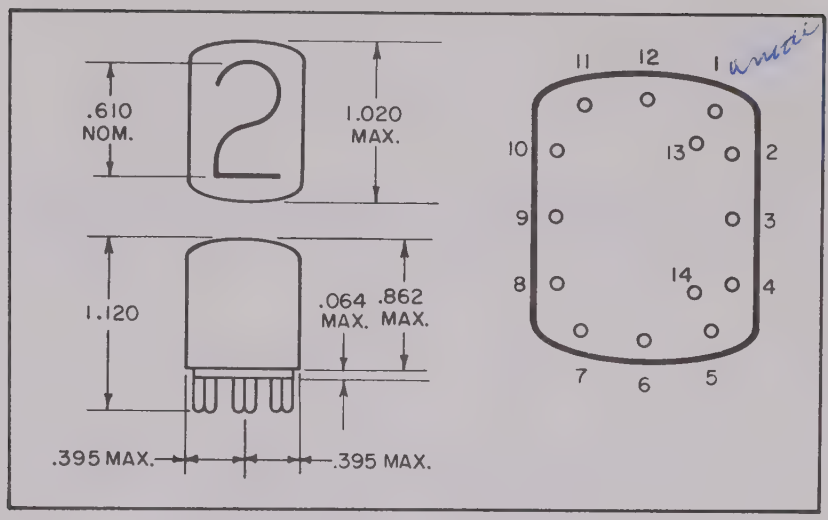


Fig. 1. Glow-Tube Specifications

The COUNT function of Model 6020 has been replaced by a Time Interval (TIM) function in the Model 6030A. The TIM function is used to measure time intervals between an input X and an input Y. The first input X after reset starts the function, and the next input Y stops the function. The resolution of the TIM function is given by $N \cdot M \cdot 10^{-5}$. Thus, the maximum resolution is 10 microseconds and the minimum resolution is 100 seconds. With the resolution set to 100 seconds, the instrument is capable of measuring intervals up to 10^7 seconds.

OPERATION

Figure 2-1 in the appended instruction manual is no longer applicable. All discussion pertaining to the COUNT function should be ignored. Table 2-1, Types of Measurements, on page 2-3 should be changed for Model 6030A only by replacing COUNT (X/NM) with the following:

TIM (X-Y)	Measures the interval between events at X and Y in increments of $N \cdot M \cdot 10^{-5}$ seconds. The first input at X after reset triggers the count and the next input at Y stops the count. If $N \cdot M$ is set to 1, readout will display interval in tens of microseconds. If $N \cdot M$ is set to 10^7 (00000 x 100) the readout will display interval in hundreds of seconds.

THEORY OF OPERATION

The five count-chain DCU's (decimal counting units) described in paragraph 3.12 of the appended instruction manual have been replaced by five DCU's which are designed to drive glow-tube indicators. Refer to the Bi-Quinary DCU (Forward Only - Latched) Schematic Diagram (dwg. no. D427199).

The basic counting circuitry in these DCU's is the same as that used in the previous DCU's. However, the output from this DCU consists of ten lines in decimal code; each drives a single cathode in the glow-tube indicator associated with the DCU. These ten lines are derived from the basic counting circuitry via ten buffer amplifiers. Table 2 shows the interconnections between the DCU and the glow-tube indicator. This table replaces Figure 3-17 in the appended instruction manual.

Table 2. DCU to Glow-Tube Interconnections

Glow-Tube Numeral	DCU Pin Number	Glow-Tube Socket Pin Number
0	3_R	2
1	4_R	11
2	5_R	10
3	6_R	9
4	7_R	8
5	8_R	7
6	9_R	6
7	10_R	5
8	11_R	4
9	12_R	3

For Model 6030A only, Section 3.6 in the appended instruction manual should be changed to read as follows:

3.6 TIM (X-Y) OPERATION

1) The FUNCTION switch in the TIM position opens a set of logic gates on the TIM (X-Y) Function Board.
2) Count gate opens on the first X input.
3) M DCU's accumulate every clock pulse. (M selectable in decades on front panel of instrument.)
4) Preset N DCU's accumulate once each time the M DCU's reach $\overline{M-1}$. (N selectable by means of "N" switches on front panel of instrument.)
5) Readout DCU's count once each time the M and N DCU's reach M-1 and preset N-1, respectively.
6) Count gate closes on the next Y input pulse.
7) Readout displays the number of groups of N·M events between input at X and Y.

The following description of Model 6030A TIM Function should replace Section 3.9.4 in the appended instruction manual:

Figure 2 shows the basic logic diagram for the TIM Function Board. With the FUNCTION switch in the TIM position, the start, accumulate M, and stop gates are controlled open. An X input starts the count.

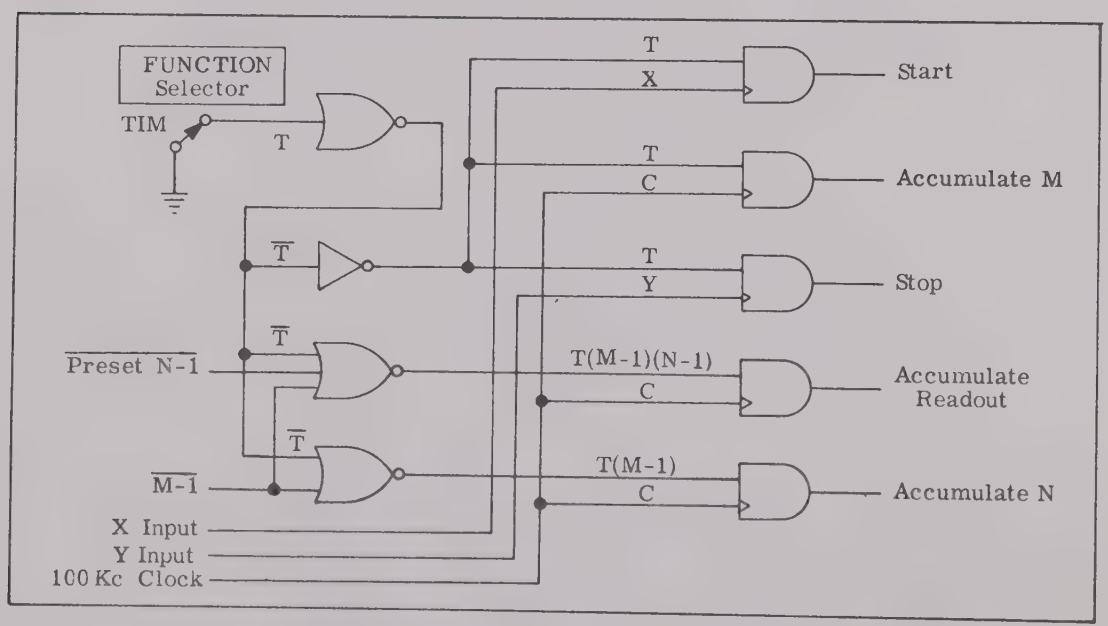


Fig. 2. Basic TIM Logic

The accumulate N gate is controlled open when the M DCU's have accumulated M-1 clock pulses. The accumulate readout gate is controlled open when the N DCU's have counted N-1 and the M DCU's have counted M-1 events. The accumulators count until a Y input pulse stops the count.

SERVICING

A change has been made in the power supply; the -32 volts dc supply has been replaced by a +175 volt dc supply, which is used to energize the anodes of the glow-tube indicators.

Figure 3 replaces Figure 4-1, and Figure 4 replaces Figure 4-2 in the appended instruction manual.

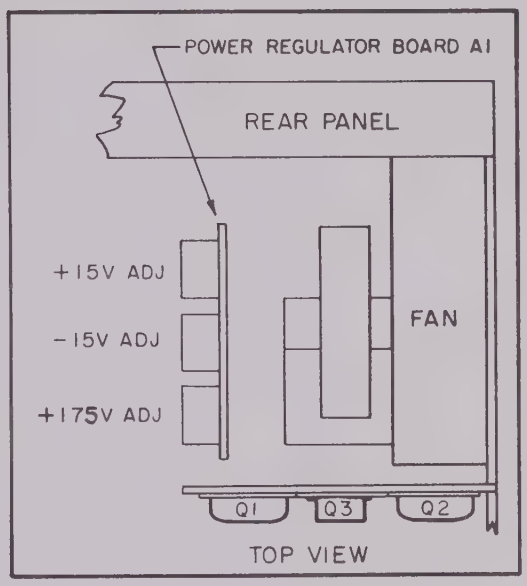


Fig. 3. Location of Power Supply Adjustments

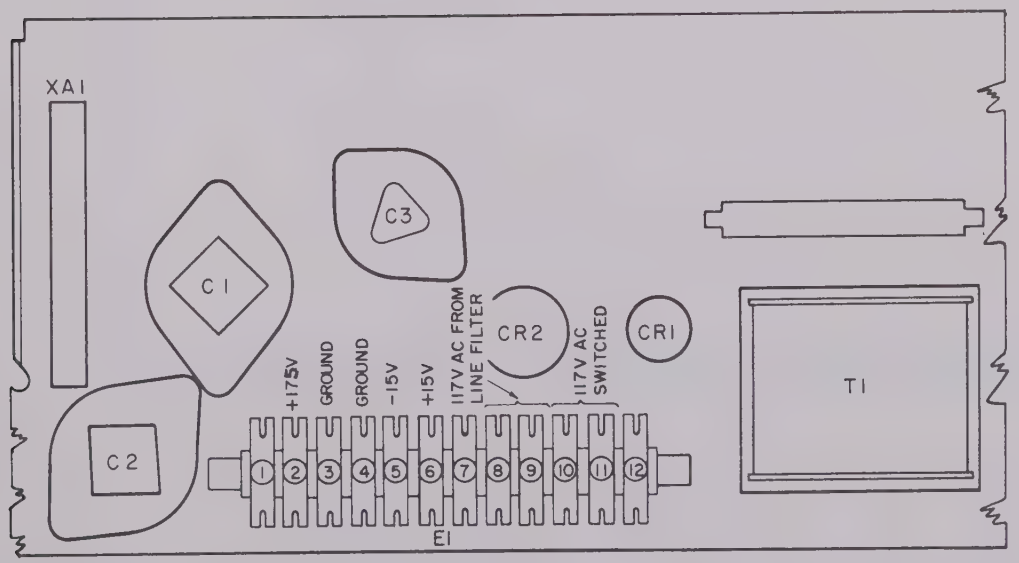
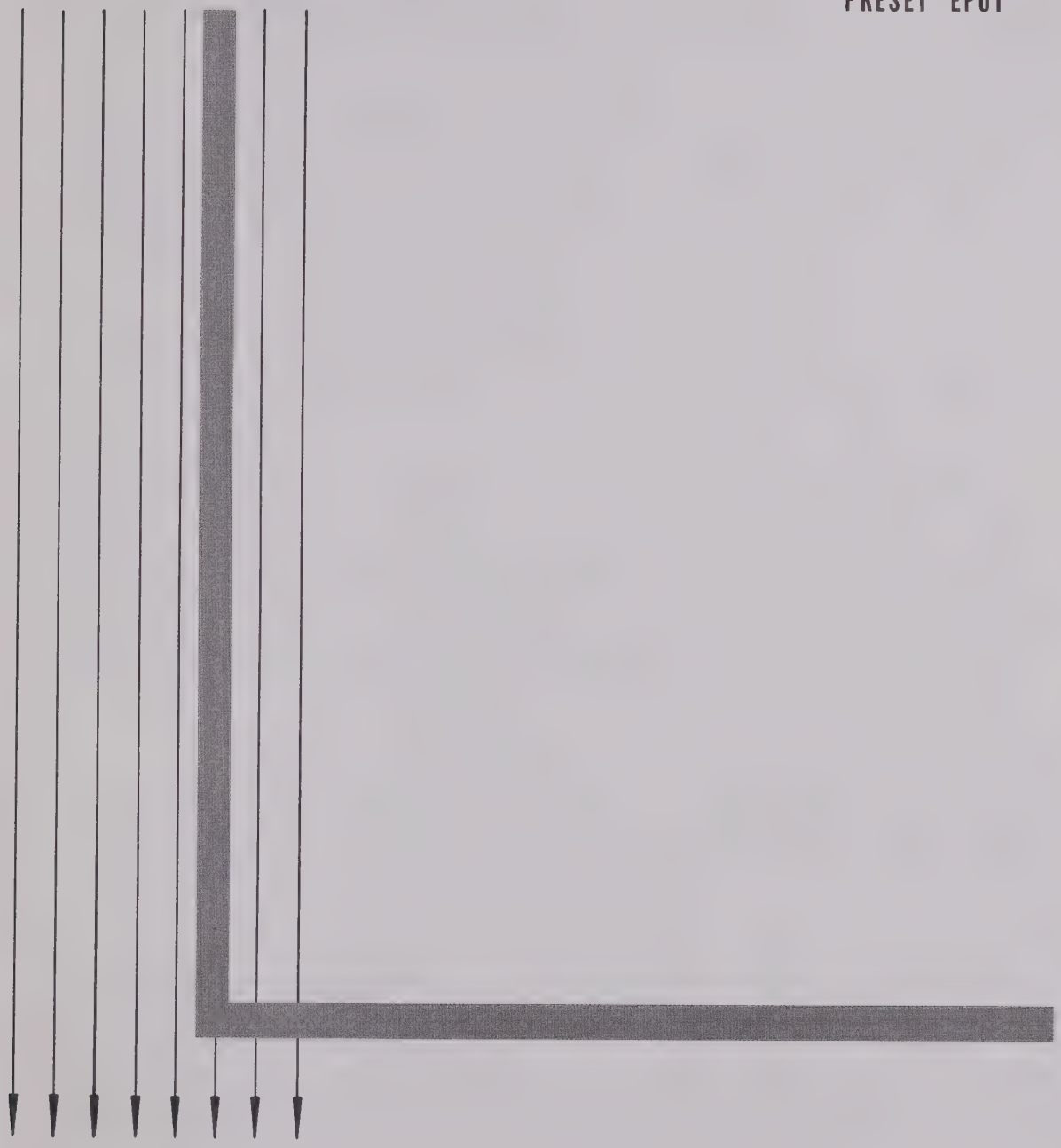


Fig. 4. Power Supply Test Points

INSTRUCTION MANUAL

MODEL 6020

PRESET EPUT®



Beckman® INSTRUMENTS, INC.

ELECTRONIC INSTRUMENTS DIVISION

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September 1965

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COMPONENT LAYOUT DRAWINGS

Input Amplifier P.C. Board	C426372
Gate Control P.C. Board	D425446
Time Base Logic P.C. Board	C424721
Timing Control P.C. Board	D426251
Bi-Quinary DCU without Readout (Forward only)	C426107
Bi-Quinary DCU with Readout (Forward only)	C426103
Preset Output P.C. Board	C426432
"Count" Function P.C. Board	D425480
"Period" Function P.C. Board	D425481
"Ratio" Function P.C. Board	D425482
"Eput" Function P.C. Board	D425479
Outline Drawing	65-C-6020

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Input Amplifier Schematic	D426510
Gate Control Schematic	D425344
100 KC/1 MC Oscillator Schematic	C424009
Time Base Logic Schematic	B424591
Timing Control Schematic	D424590
Function Board Logic Elements Schematic	C425615
Preset Output Schematic	C426501
Bi-Quinary DCU, Forward Only, Schematic	D426100
"Count" Function Board Logic Diagram	C425620
"Period" Function Board Logic Diagram	C425618
"Ratio" Function Board Logic Diagram	C425619
"Eput" Function Board Logic Diagram	C425617
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SECTION 1

INTRODUCTION

1.1 GENERAL

This instruction manual provides all the information required for the operation, basic understanding, and servicing of the Beckman 2 mc solid-state preset frequency counter.

The Model 6020 periodically takes measurements of frequency, period, and frequency ratio. It can also operate as a simple forward counter having an absolute storage capacity of 99,999.

In the REMOTE position, all functions can be controlled by an appropriate contact closure to ground on a rear panel remote connector.

A special feature of the Model 6020 is the built-in flexibility in the circuitry. Functions not specified on the front panel are, in most cases, easily achieved upon request by the customer.

The Model 6020 is especially useful as a frequency counter. Frequency is displayed in any units desired by simply preselecting the desired conversion factor.

1.2 SPECIFICATIONS

Specifications for the Model 6020 are given in Table 1-1.

Table 1-1. Specifications

Rate	DC to 2 mc.
Display	Five-digit edgelit with GATE OPEN indication.
Preset	Five thumbwheel switches for 5-digit PRESET N selection.

continued. . .

Table 1-1. Specifications - continued

Input Signal	Two channels, X and Y. Pulse width at least 0.5 μs. Pulse separation at least 0.5 μs. Sensitivity: 100 mv to 50 v.
Input Impedance	20,000 ohms at 100 mv.
Triggering Level	X and Y, both internal adjustments: ±10 v.
Slope Select	X and Y by contact closure to ground on remote connector.
Oscillator	Frequency: 100 kc. Stability: 3 parts in 10^7 per day at 25°C. ±1 part in 10^5 per day with ±10°C deviation from 25°C.
Data Storage	Visual storage; 1-2-4-8 BCD.
Operating Temperature	0 to 55°C.
Dimensions	3-1/2" x 19" x 17" HWD.
Weight	29 lbs.
Power	115/230 volts ±10%. 50/60 cycles, 60 watts.

1.3 OPTIONS

The options available to the standard instrument are listed in Table 1-2.

Table 1-2. Options

DE	Relay-rack slides. On request.
DH	230 V ac line voltage. Power transformer wired for 230 V, ±10%, 50 to 60 cycles.

continued. . .

Table 1-2. Options - continued

DM	Addition of sixth digit and OVERFLOW display.
DN	Remote display. Data output for remote display available at rear panel connector. Includes cover plate for vacated front panel display.
DQ	Tilt-foot handles to replace rack handle adapters.

SECTION 2

OPERATION

2.1 GENERAL

The Model 6020 accepts two inputs and can provide information on frequency and period. It can also operate as a forward counter. Figure 2-1 shows the front panel with readout display and front panel controls. X and Y input connectors are located on the rear panel as shown in Figure 2-2.

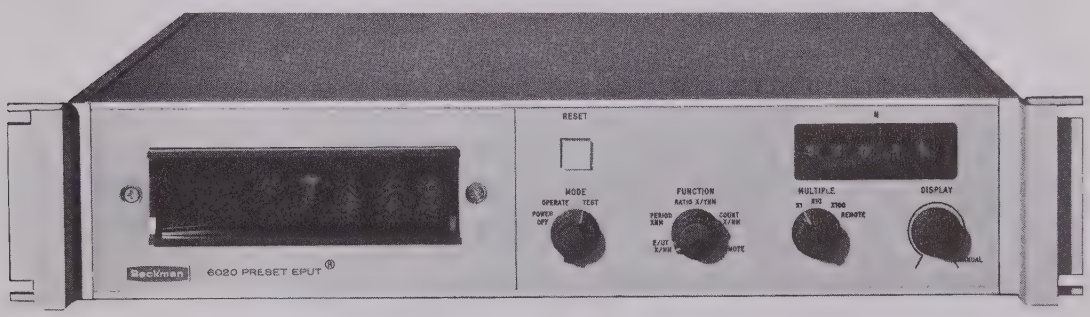

Fig. 2-1. Model 6020 Front Panel

2.2 APPLYING POWER

The instrument is ready to use as it arrives from the factory. To energize the unit, plug the power cord into a 117 v ac, 50-60 cycle source. The crystal oscillator circuit energizes immediately. Turn the MODE switch to OPERATE or TEST, energizing all circuits in the instrument.

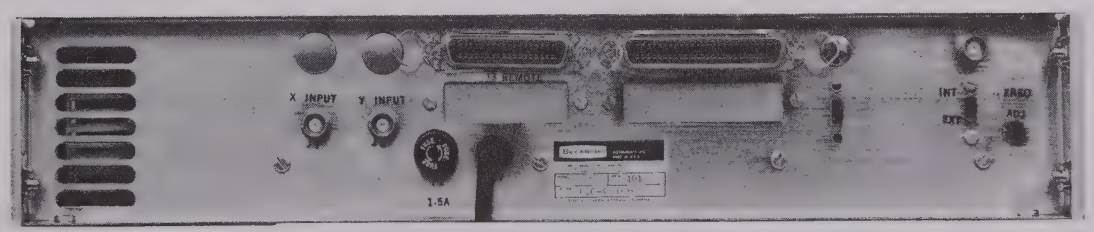

Fig. 2-2. Model 6020 Rear Panel

2.3 TYPES OF MEASUREMENTS

The Model 6020 has two input circuits, X and Y. The E/UT, PERIOD, and COUNT functions utilize only the X input. Operations performed by the instrument are described below.

2.3.1 Definition of Symbols

X refers to X input.

Y refers to Y input.

N refers to the 5-digit preset number.

M refers to the multiple factor indicated by the MULTIPLE switch: X1, X10, X100.

2.3.2 Measurements

The FUNCTION switch selects the operations performed by the instrument. The operation associated with each position is listed in Table 2-1.

Table 2-1. Types of Measurements

Function Position	Measurement
E/UT (X/NM)	Counts the number of X input occurring within (N·M) 10 microseconds. Readout displays number of events at X within this time interval. If N·M is set to 10^5 (1 second time base) readout will display frequency of X in cps. In general, frequency of X (cps) is obtained by dividing readout by (NM) 10^{-5} seconds.
PERIOD (XNM)	Measures the time required for NM events to occur at X. Readout displays time in 10's of microseconds. If X is periodic and NM is set to 10, readout will display period directly in microseconds. In general, average period (in seconds) is obtained by dividing readout by (N·M) 10^5.
RATIO (X/YNM)	Counts events occurring at X within the time required for N·M events to occur at Y. If

continued. . .

Table 2-1. Types of Measurements - continued

Function Position	Measurement
RATIO (X/YNM) continued	X and Y are both periodic and NM is set to a convenient multiple of 10, readout will display frequency ratio of X to Y multiplied by the selected multiple. In general, frequency ratio is obtained by dividing readout by NM.
COUNT (X/NM)	Counts events at X in groups of NM. An output pulse is generated (Pin 8 on remote connector) each time the instrument has counted a multiple of NM. To stop counting, switch the FUNCTION selector to REMOTE. (Care must be taken to insure that Pins 10, 11, 12, 13 on remote connector are left open or else the instrument will continue to operate in one of the above modes.)
REMOTE	Operating mode is selected by grounding the proper pin on the remote connector. With the FUNCTION selector in this position, Pin 9 on remote connector becomes ground. FUNCTION is selected by connecting Pins 10, 11, 12 or 13 to Pin 9 (see Table 2-6 for remote connector pin numbering).

TIM (6030A) See page 2 of Section [illegible] in front)

2.4 EXTERNAL CONTROLS AND CONNECTORS

Most operating controls are located on the front panel and are shown in Figure 2-1. X and Y input connectors (J1 and J2, respectively), remote connector (J3), and data output connector (J4) are located on the rear panel along with the oscillator adjustment and terminal. These are shown in Figure 2-2.

Each front panel control is explained in Table 2-2. Rear panel connectors and adjustments are explained in Table 2-3.

Table 2-2. Front Panel Controls

FUNCTION Selector	Each position is explained in Table 2-1.
5-Digit N-Select Switches	Selects the N preset number referred to on the FUNCTION selector.
MODE Selector	In the TEST or OPERATE positions, the instrument is energized. TEST: X and Y inputs are disabled and replaced by a 100kc test signal. Instrument operates on test signal according to mode indicated by FUNCTION selector. OPERATE: Instrument operates on X and Y inputs as indicated by the FUNCTION selector.
MULTIPLE Selector	Effectively multiplies N-preset by a factor of 1, 10 or 100. REMOTE position allows remote selection of multiple factor by an appropriate contact closure in the remote connector.
DISPLAY Control	Controls display time. With the control fully counter-clockwise, the instrument is set for minimum display time and maximum sampling rate. Turning the control clockwise extends display time and decreases sampling rate. In the MANUAL position, the instrument no longer recycles after the sampling interval and must be manually or remotely reset.

Table 2-3. Rear Panel Connectors and Adjustments

X and Y Inputs J1 and J2 respectively)	Data input connectors.
Remote Connector (J3)	Provides remote selection of slope, function and multiple. Provides remote

continued. . .

Table 2-3. Rear Panel Connectors and Adjustments - continued

Remote Connector (J3) continued	reset. Start, stop and preset outputs are off the remote connector. (Refer to Section 2.4.2.)
INT-EXT Switch	INT: Internal oscillator is used as time base and can be monitored at FREQ connector. EXT: Disconnects oscillator output; allows use of external time base.
FREQ. ADJ.	Used for fine adjustment of oscillator frequency.
FREQ. Connector (J5)	Performs either of two functions depending on position of INT-EXT switch. INT: Internal oscillator can be monitored at J5. EXT: An external signal can be applied at J5 to substitute for internal oscillator. External signal must be between dc and 1 mc and capable of producing 3 volts p-p across 3000 ohms.

2.4.1 Data Output Connector

This 50-pin socket is wired to the readout lines of each storage binary and provides positive true 1-2-4-8 binary coded decimal outputs to auxiliary equipment such as printer, display unit and data converter. Table 2-4 shows the binary code generated by the readout binaries representing each decimal digit. Table 2-5 lists connector pin numbering.

Positive true logic levels are: logic "0" = -10 volts or greater, logic "1" = -0.3 volt to ground.

Table 2-4. Four-Line Binary Code

Decimal Digit Registered	1st Binary (Wt. 1)	2nd Binary (Wt. 2)	3rd Binary (Wt. 4)	4th Binary (Wt. 8)
0	0	0	0	0
1	1	0	0	0
2	0	1	0	0
3	1	1	0	0
4	0	0	1	0
5	1	0	1	0
6	0	1	1	0
7	1	1	1	0
8	0	0	0	1
9	1	0	0	1

Table 2-5. Output Connector Pin Numbering

Displayed Decimal	1st Binary (Wt. 1)	2nd Binary (Wt. 2)	3rd Binary (Wt. 4)	4th Binary (Wt. 8)
10^0	Pin 1	Pin 2	Pin 26	Pin 27
10^1	Pin 3	Pin 4	Pin 28	Pin 29
10^2	Pin 5	Pin 6	Pin 30	Pin 31
10^3	Pin 7	Pin 8	Pin 32	Pin 33
10^4	Pin 9	Pin 10	Pin 34	Pin 35
10^5 (option)	Pin 11	Pin 12	Pin 36	Pin 37

Pin 25 - Inhibit Recycle. Carries an "inhibit recycle" command from the accessory to the instrument. When this pin is at ground, the instrument cannot recycle.

Pin 49 - Accessory Command. Carries a control signal from the instrument to the auxiliary recorder. This pin is negative (-10 volts or more negative) for 50 milliseconds and at approximately ground potential from the time of reset until the next accessory command.

Pin 50 - Ground.

2.4.2 REMOTE Connector (J3)

This is a 36-pin connector located on the rear panel which allows remote selection of slope, function and multiple. It also provides a means for remote reset. This is accomplished by having the specific front panel master control(s) in REMOTE and grounding the proper pin(s) on the remote connector. (See Table 2-6.)

The remote connector also provides outputs which indicate instants of start, stope and NM. The last signal is most useful during the COUNT operation when an output pulse would be generated each time the instrument has counted a multiple of NM. Output pulses are approximately 200 nanoseconds and 10 volts positive true. Table 2-5 shows the function associated with each pin on the remote connector.

Table 2-6. Remote Connector Pin Numbering

Pin Number	Function	Pin Number	Function
1	X-Slope Select	19	Y-Slope Select
2	Ground	20	Ground
3	*	21	*
4	*	22	*
5	*	23	*
6	Start Output	24	Ground (twisted with 6)
7	Stop Output	25	Ground (twisted with 7)
8	Preset Output	26	Ground (twisted with 8)
9	FUNCTION Switch Remote Pos.	27	*
		28	*
10	RATIO	29	*
11	EPUT		
12	COUNT	30	*
13	PERIOD	31	X1000
14	*	32	*
15	MULTIPLE Switch Remote Pos.	33	*
		34	*
16	X1		
17	X10	35	Ground
18	X100	36	Remote Reset

* Not used in standard instrument.

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2.5 INTERNAL CONTROLS

2.5.1 Triggering Level Adjustment

The triggering level adjustment and test points are located on the amplifier boards and are accessible from the top of the instrument. There are two test points marked on the board: LEVEL and TEST. Voltage appearing at LEVEL is the actual triggering level, i.e., value which the input voltage must exceed in order to trigger the input circuit. Voltage appearing at TEST is the actual output from the amplifier. A simple adjustment procedure is outlined below.

1) Connect a voltmeter of at least 1% accuracy to the LEVEL test point and an oscilloscope to the TEST output.

2) Connect a signal generator to the amplifier input and set the rms voltage to the desired level using a 100kc signal.

3) Using the potentiometer mounted on the amplifier board, adjust the discriminator desired sensitivity. Maximum sensitivity is indicated by the appearance of an output pulse train with approximately 50% duty cycle.

4) The actual triggering level (plus hysteresis) is indicated by the dc voltmeter. A reading of approximately 0 volts indicates maximum sensitivity.

2.5.2 Slope Selection

The slope control is a contact closure to ground on the remote connector (pin 1 for X and 19 for Y). It determines which slope, positive or negative, of the input signal will trigger an output pulse. Figure 3-4 in Section 3 shows the voltage discriminator output with a sine wave input, and the effect of + and - slope switch positions.

The slope selection procedure is as follows:

1) For positive (+) slope triggering, pin 1 or 19 (X or Y input, respectively) on the remote connector (J3) is left open circuited.

2) For negative (-) slope triggering, the pin is grounded.

2.6 TEST OPERATION 6020

The TEST position of the MODE selector provides a quick, uncomplicated method of checking the instrument for proper operation. A simple test procedure is outlined as follows:

1) Set MODE switch to TEST.

2) Set DISPLAY to an intermediate position.

3) Set NM to any arbitrary number.

4) Set FUNCTION to EPUT. Display should latch on NM.

5) When FUNCTION is switched to PERIOD or RATIO, display should latch on NM.

6) Set FUNCTION selector to COUNT X/NM and NM = 100,000.

7) Press the RESET button. Display should follow and update at a rate of 1 count per second. With NM = 500,000, display should follow and update at the rate of 1 count per five seconds.

SECTION 3

GENERAL OPERATING THEORY

3.1 GENERAL

This section describes the basic operating theory of the Model 6020. Information in this section is primarily from a functional approach and minimizes any detailed description of circuit operation.

Logic symbols are defined in the Appendix and are listed along with typical circuits.

A block diagram of printed circuit boards in the Model 6020 is shown in Figure 3-1, a fold-out page at the end of this section.

3.2 TIMING SEQUENCE

As shown in Figure 3-2, the operations within the Model 6020 follow this sequence:

1) Reset.
2) Start count.
3) Stop count.
4) Transfer data to readout.
5) Display stored data.
6) Automatic reset and recycle.

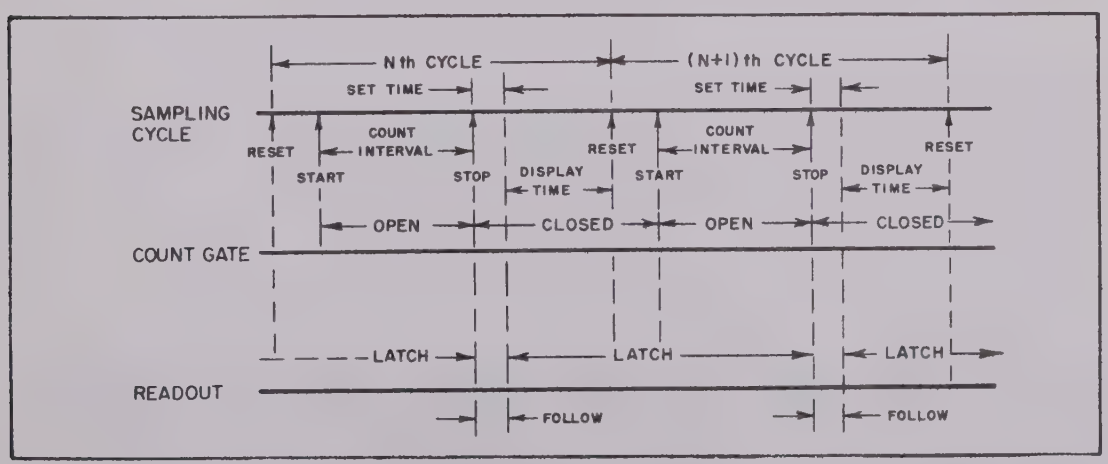


Fig. 3-2. Timing Diagram for EPUT, PERIOD, or RATIO Operation. In COUNT instrument does not recycle, count gate remains open, and display follows readout DCU's.

3.2.1 Reset

The instrument can be reset manually local or remote, or automatically by the display timer at the end of display time.

3.2.2 Start Pulse

The "start" pulse opens the count gates to the decimal counting units. It is triggered in the following ways, depending on the function.

1) In EPUT: on the following clock pulse.
2) In PERIOD: on the following X input.
3) In RATIO: on the following Y input.
4) In COUNT: on the following clock pulse.

3.2.3 Stop Pulse

The "stop" pulse closes the count gates to the decimal counting units. It occurs under the following conditions after the N and M DCU's reach preset N and M, respectively:

1) In EPUT: on the following clock pulse.
2) In PERIOD: on the following X input.
3) In RATIO: on the following Y input.
4) In COUNT: the count gate remains open.

3.2.4 Count Interval

The count interval between start and stop pulses depends on the X and Y input frequencies and N and M settings. When the FUNCTION switch is in COUNT, the interval has an indefinite duration because the count gate remains open.

3.2.5 Set Time

The "set", or transfer to storage time, is approximately 1 millisecond in the standard instrument. During this interval, the display is in the "follow" mode; that is, information in the readout DCU's is transferred to storage. It remains stored until the next "set" interval. During this time, it follows and stores the new readout.

3.2.6 Display Time

Display time is the time interval during which stored data is available to accessory equipment for recording.

The front panel DISPLAY control serves to alter the time constant of the display circuit on the Timing Control Board. The display interval is adjustable between approximately 0.1 second and 10 seconds.

3.3 EPUT (X/NM) OPERATION

1) The FUNCTION selector in EPUT opens a set of logic gates on the EPUT Function Board.
2) Count gate opens on the following clock pulse.
3) Readout DCU's count every X input while the gate is open.
4) M DCU's count every clock pulse.
5) Preset N DCU's count once each time the M DCU's reach M.
6) When the preset N DCU's reach N preset and the M DCU's reach M-1, the "stop" gate is controlled open for the next clock pulse, which serves to close the count gates.
7) Therefore, the readout DCU's have counted the number of events at X during a (N·M) 10 microsecond interval. (6020) (1μS=6040)

3.4 PERIOD (XNM) OPERATION

1) The FUNCTION selector in PERIOD opens a set of logic gates on the PERIOD Function Board.
2) Count gate opens on the following $\dot{X}$ input.
3) Readout DCU's accumulate every clock pulse.
4) M DCU's accumulate every X input.
5) Preset N DCU's count once each time the M DCU's reach M.
6) When M and N DCU's reach M-1 and N-preset, respectively, the stop gate is controlled open for the next X input, which closes the count gate.
7) The readout displays the time in 10's of microseconds required to receive N·M X inputs. (6020)

3.5 RATIO X/YNM OPERATION

1) The FUNCTION selector opens a set of logic gates on the Ratio X/YNM Function Board.
2) Count gate opens on the following clock pulse.
3) Readout DCU's accumulate every X input.
4) M DCU's accumulate every Y input.
5) Preset N DCU's count once each time the M DCU's reach M.
6) When M and N DCU's reach M-1 and N-preset, respectively, the stop gate is controlled open for the next Y input which closes the count gate.
7) The readout displays the number of events at X during the interval required for N·M events at Y.

3.6 COUNT (X/NM) OPERATION

1) The FUNCTION switch in COUNT opens a set of logic gates on the Count X/NM Function Board.
2) A signal from the Function Board goes to circuitry in the Timing Control Board and causes the readout control lines to assume the "follow" condition.
3) Count gate opens on the next clock pulse.
4) M DCU's accumulated every X input.
5) Preset N DCU's accumulate once each time the M DCU's reach M-1.
6) Readout DCU's count once each time the M and N DCU's reach M-1 and preset N-1, respectively.
7) Readout displays the number of groups of N·M events at X.

3.7 PRESET/OUTPUT BOARD

The Preset/Output Board contains three single-shot circuits which provide outputs to accessory recording instruments. Pulses on the three output lines indicate one of the following:

a) Instant when the count gate is opened.
b) Instant when the count gate is closed.
c) Instants when the instrument has counted a multiple of NM bits of data.

The last condition (c) is especially useful when the instrument is operating as a simple counter.

These signals appear on pins 6, 7, and 8, respectively, on the remote connector. Each single-shot generates a positive true pulse, (-10 volts to ground) approximately 200 nanoseconds wide.

3.8 INPUT AMPLIFIERS

The input amplifiers consist of a discriminator-amplifier input circuit followed by slope selection logic.

The input circuit is a differential amplifier using regenerative positive feedback. The use of such feedback and dc switching levels insures the fast switching time which is essential in high frequency applications.

The slope selection logic permits triggering on either the positive or negative slopes of the input signal. An input to the discriminator circuit generates a 0.6 volt p-p positive true signal to the slope selection circuitry and appears at the amplifier output as a positive true pulse (-7 v to ground). If a positive slope is selected, the output is triggered by the leading edge of the discriminator output; whereas, if a negative slope is selected, the output is triggered by the trailing edge. Figure 3-3 gives the slope selection logic. Figure 3-4 shows the result of amplifier discrimination and slope selection.

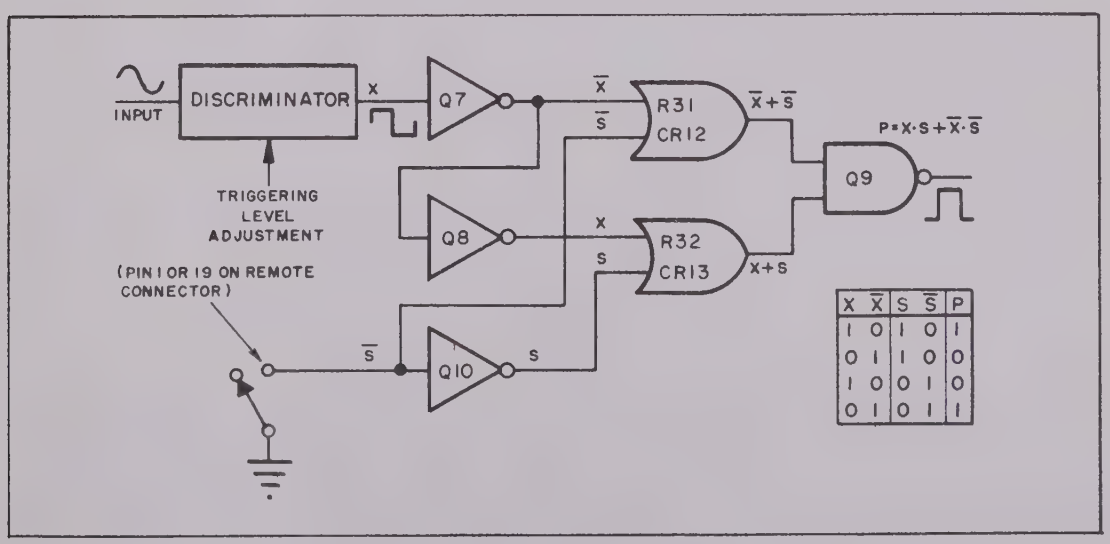


Fig. 3-3. Slope Selection Logic Diagram

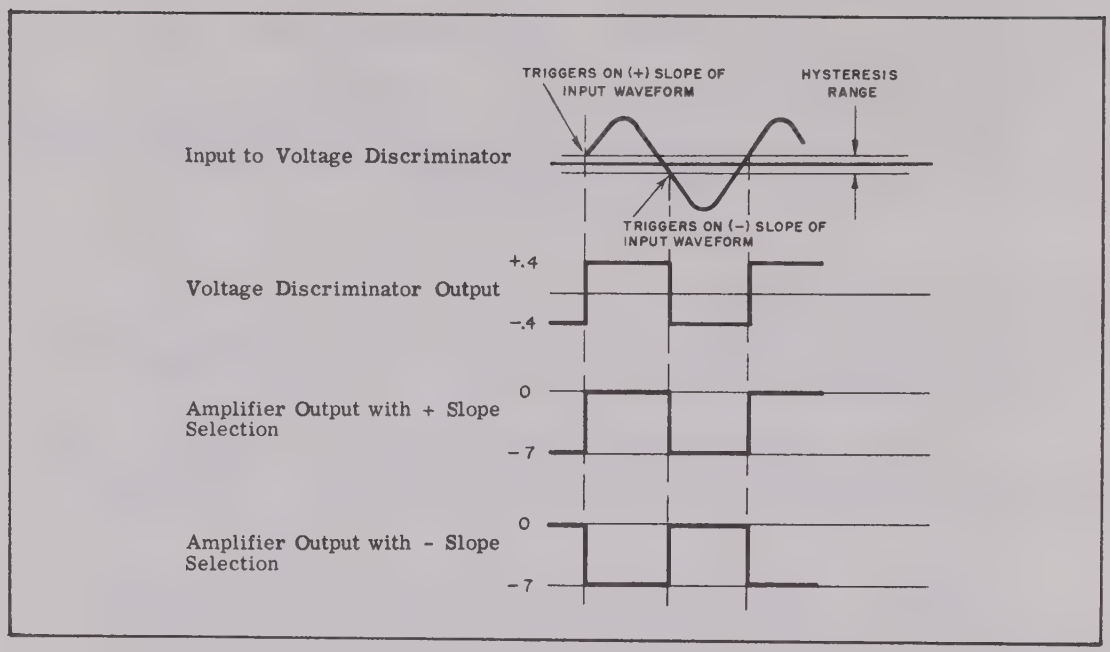


Fig. 3-4. Amplifier Input and Output Signals

3.9 FUNCTION BOARDS

3.9.1 General Theory of Operation

Each of the four Function Boards perform as basic logic gates. The start, stop, accumulate N·M and readout pulses all originate from one of the four logic boards, depending on the function selected. Each board selects the specific conditions under which each of the five above mentioned pulses are generated.

Auxiliary inputs and outputs to and from each board allow for flexibility in the functions performed by the instrument.

3.9.2 EPUT and PERIOD Functions

Figures 3-5 and 3-6 show the basic logic diagram for the EPUT and Period XNM Function Boards, respectively. With the FUNCTION selector in EPUT or PERIOD, the start, accumulate M, and readout gates are controlled open. The stop gate is controlled open when the N and M DCU's have accumulated N-1 and M-1 events, respectively. The

accumulate N gate is controlled open each time the M DCU's have accumulated M-1 events. Outputs to the Gate Control Board are then triggered by clock or X input pulses which occur immediately after the gates are controlled open.

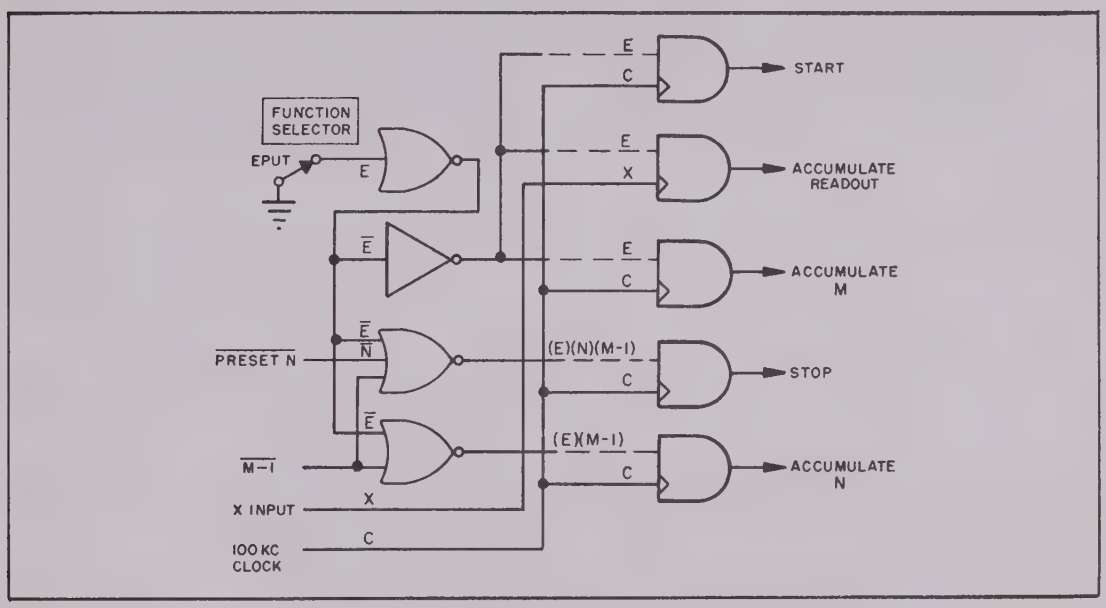


Fig. 3-5. Basic EPUT Logic

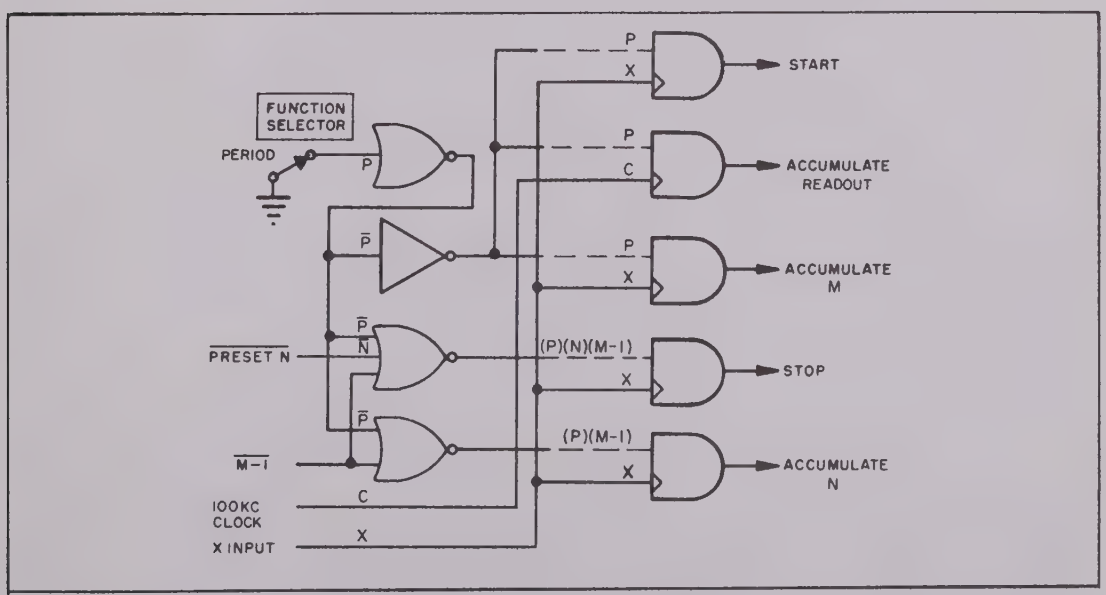


Fig. 3-6. Basic PERIOD Logic

3.9.3 RATIO Function

Figure 3-7 shows the basic logic diagram for the RATIO Function Board. With the FUNCTION selector in RATIO, the start, accumulate readout and accumulate M gates are controlled open. The stop gate is controlled open when the N and M DCU's have accumulated preset N and M-1 events, respectively. The accumulate N gate is controlled open each time the M DCU's reach M-1. Outputs to the Gate Control Board are then triggered by X or Y input pulses occurring at the next instant of time.

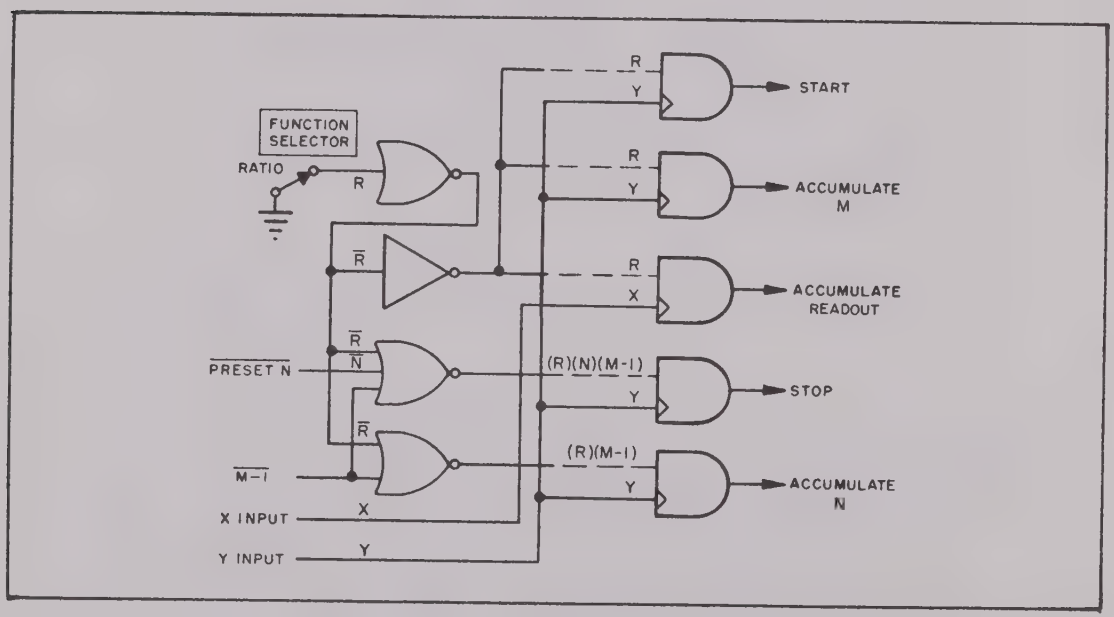


Fig. 3-7. Basic RATIO Logic

3.9.4 COUNT Function

Figure 3-8 shows the basic logic diagram for the Count Function Board. With the FUNCTION selector in the COUNT position, the start and accumulate M gates are controlled open. The accumulate readout and auxiliary reset gates are controlled open when the N and M DCU's have accumulated preset N and M-1 events. respectively. The accumulate N gate is controlled open when the M DCU's have accumulated M-1 events. Outputs to the Gate Control Board are then triggered by clock or X input pulses occurring at the next instant of time.

DC levels to the Timing Control Board are used to cause the readout display to continually follow the readout DCU's. These levels appear on control lines #1 and #2 from the Timing Control Board (pins M_R and N_R, respectively).

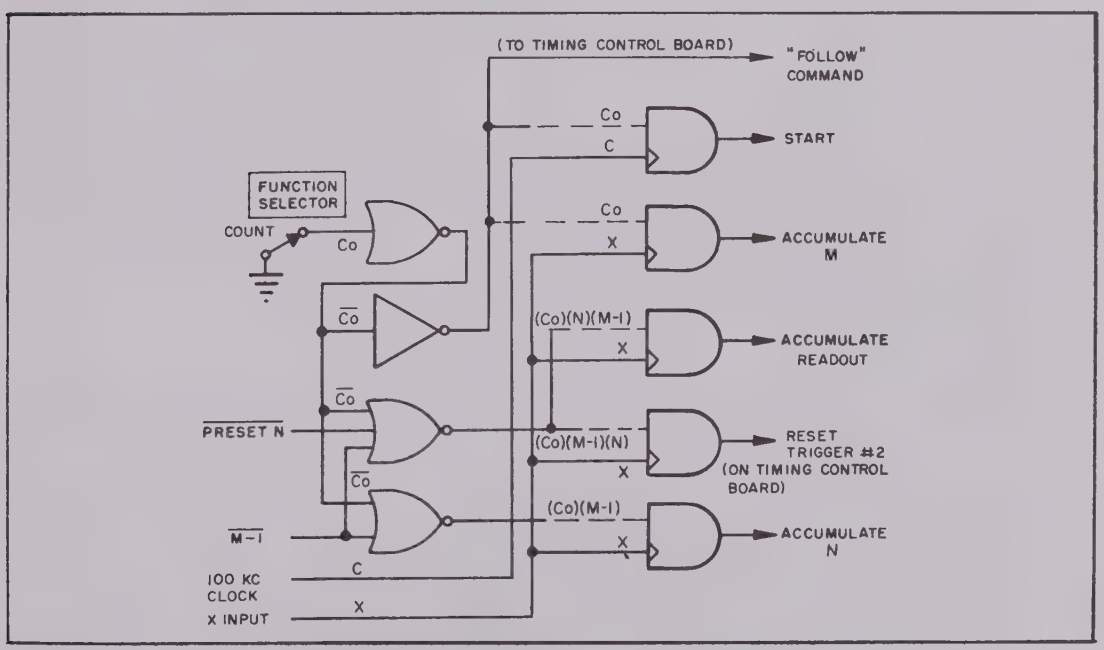


Fig. 3-8. Basic COUNT Logic

3.10 GATE CONTROL BOARD

3.10.1 Operation

The Gate Control Board controls transmission of data to the three DCU banks and the "control inhibit" signal to the Timing Control Board. Inputs to the Gate Control Board come from the four function boards.

The "control inhibit" signal to the timing control determines the time interval between stop counting and reset of DCU's. The actual DCU reset pulse is generated in the Timing Control Board.

The count gate remains closed until a "start" command is received from the function boards. Hereafter until a "stop" command is received, all data from the function board is transmitted to the three DCU banks. Figure 3-9 shows a timing diagram for the Gate Control Board.

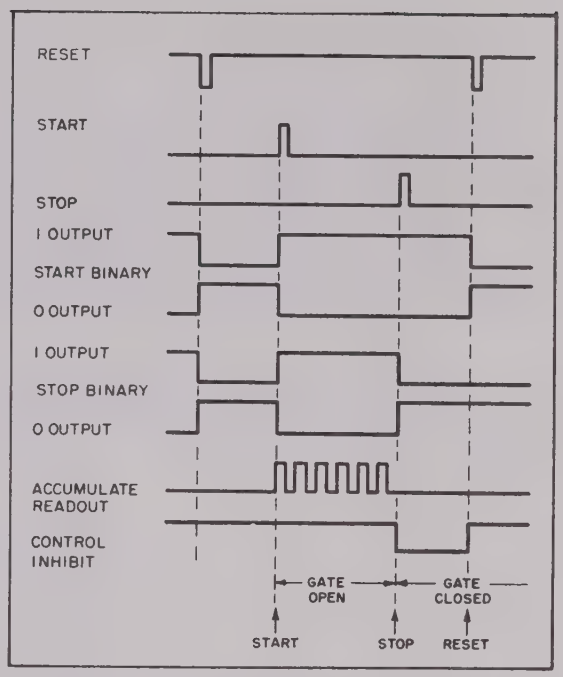


Fig. 3-9. Gate Control Board Timing Diagram

3.10.2 Description

A logic diagram for the Gate Control board is shown in Figure 3-10. The board essentially consists of two binaries (flip-flops) and three monostable multivibrators. Each of the latter generates 150 nanosecond pulses to one of the DCU banks.

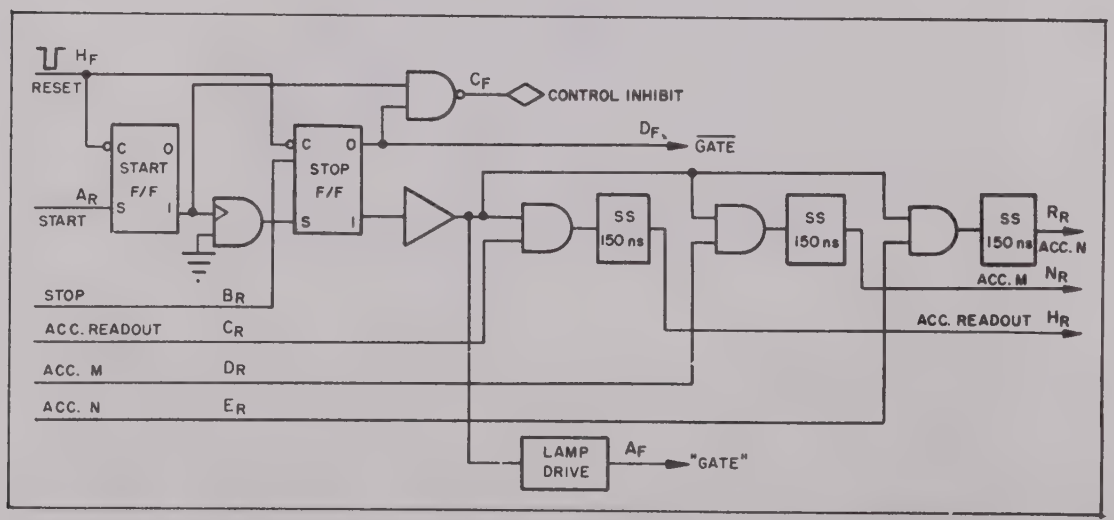


Fig. 3-10. Gate Control Board Logic Diagram

3.11 TIMING CONTROL BOARD

3.11.1 Operation

The Timing Control Board controls the count, data transfer and display time intervals for the instrument. The various control and triggering signals which initiate these intervals are generated within the Timing Control Board. Two timing circuits on the board are used to determine the set and display time intervals. Board logic is shown in Figure 3-11. The timing diagram shown in Figure 3-12 is helpful in understanding the sequence of events occurring within the board.

3.11.2 Description

The Timing Control Board uses conventional logic circuitry. The two timing circuits in the board are regenerative astable multivibrators which are designed to provide output pulses having minimum rise and fall times. At the proper instant, these circuits are unclamped from their inactive states to provide a predetermined time interval. In returning to their original states, the resulting transients are used to initiate the next sequence of events. (Refer to Figure 3-12.)

1) A "stop" pulse triggers the "control inhibit" signal to the Timing Control Board.
2) The "control inhibit" signal is delayed 100 nanoseconds and inverted.
3) The resulting signal is used to unclamp the data set timer from its inactive state. During the set interval, the display follows the readout DCU's.
4) The first positive transient from the set timer is used to clear the timing flip-flop.
5) The zero output from the flip-flop returns to ground potential, unclamping the display timer from its inactive state.
6) The display timer generates an output.
7) The zero output from the timing flip-flop is also used to reclamp the data set timer to its inactive state.
8) After the preset display interval, the display timer returns to ground potential.
9) The positive transient from the display timer is used to trigger generator #1. The generated pulse resets the gate control inhibit line. Reset generator #1 also resets the readout DCU's and the NM DCU's by triggering reset generator #2.
10) A signal from reset generator #1 is used to set the timing flip-flop.

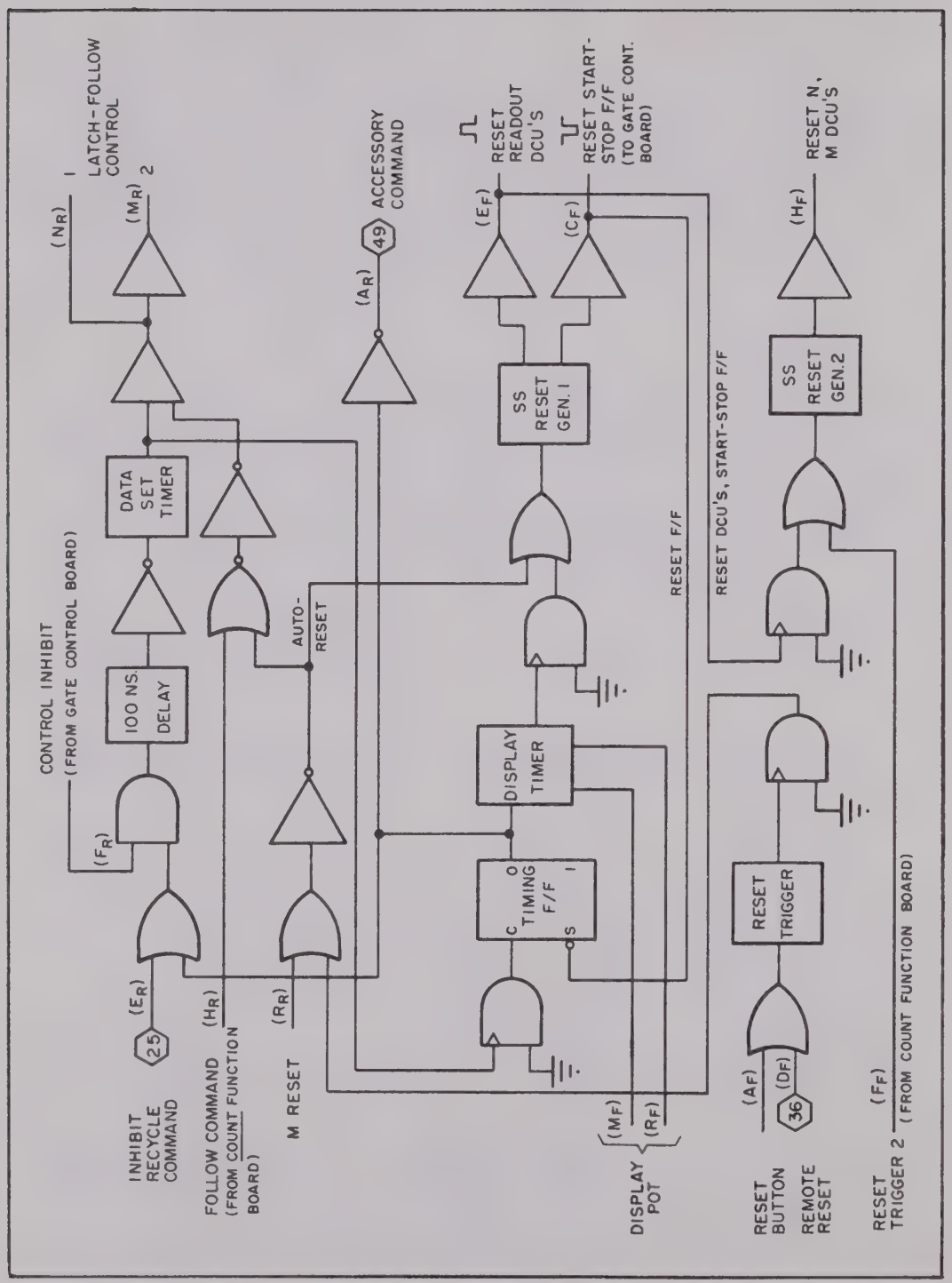


Fig. 3-11. Timing Control Board Logic Diagram

11) The presence of an "inhibit recycle" signal from accessory recording instruments delays the "data set" pulse (data transfer time) for as long a period as required to record the preceding sampled data.

3.12 DECIMAL COUNTING UNITS

The decimal counting units used in this instrument can count in the forward direction from zero to nine and generate an output "carry" pulse to the next DCU.

The basic DCU generates one output pulse for every ten input pulses. This division process is accomplished by first dividing by two and then by five. Thus, the basic counting unit is a "bi-quinary" divider. The bi-quinary decimal code is given in Table 3-1, and is represented in the circuitry by the states of seven transistors.

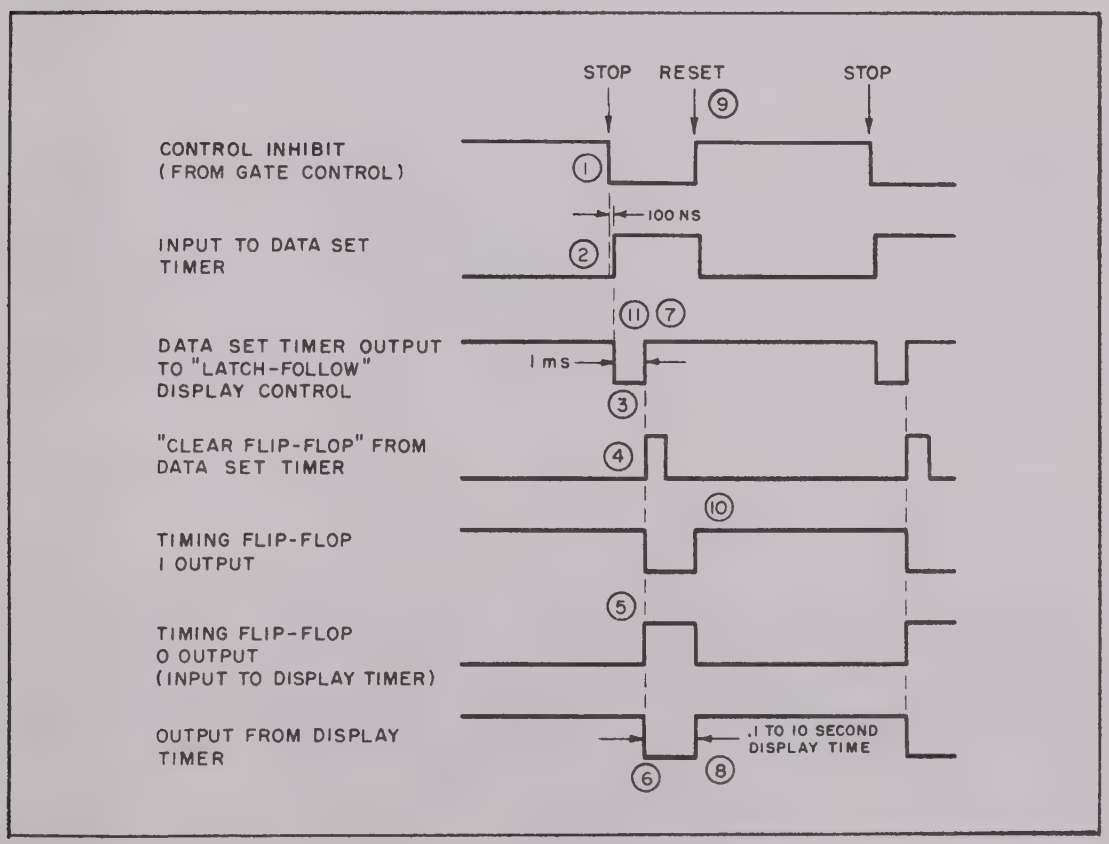


Fig. 3-12. Timing Control Board Timing Signals

Table 3-1. Bi-Quinary Decimal Code

Decimal	Binary		Quinary				
	Q1	Q2	Q7	Q8	Q9	Q10	Q11
0	1	0	1	0	0	0	0
1	0	1	1	0	0	0	0
2	1	0	0	1	0	0	0
3	0	1	0	1	0	0	0
4	1	0	0	0	1	0	0
5	0	1	0	0	1	0	0
6	1	0	0	0	0	1	0
7	0	1	0	0	0	1	0
8	1	0	0	0	0	0	1
9	0	1	0	0	0	0	1

The binary portion of the DCU is a flip-flop which reverses states whenever a forward count is received. The quinary portion of the DCU contains five transistors which can be in either the logic "1" (transistor OFF) or logic "0" (transistor ON) states. Quinary circuitry is designed such that the single OFF transistor shifts one stage to the right each time a forward count is received from the binary count gate. The DCU is designed to generate a "carry" signal to the next DCU stage upon receiving a forward count while a decimal "9" is being represented. Figure 3-13 shows the basic logic diagram for the DCU and obeys the code given in Table 3-1.

3.12.1 Multiple Time Base Logic

The "multiple" counting unit consists of a bank of three DCU's. When a multiple is chosen on the front panel, the DCU chain is terminated at a particular DCU by keeping the forward count gate from the binary portion of the DCU closed. The MULTIPLE selector switch grounds the output of one of the binary transistors through the time base logic board, thus terminating the chain of DCU's at one of the three multiples.

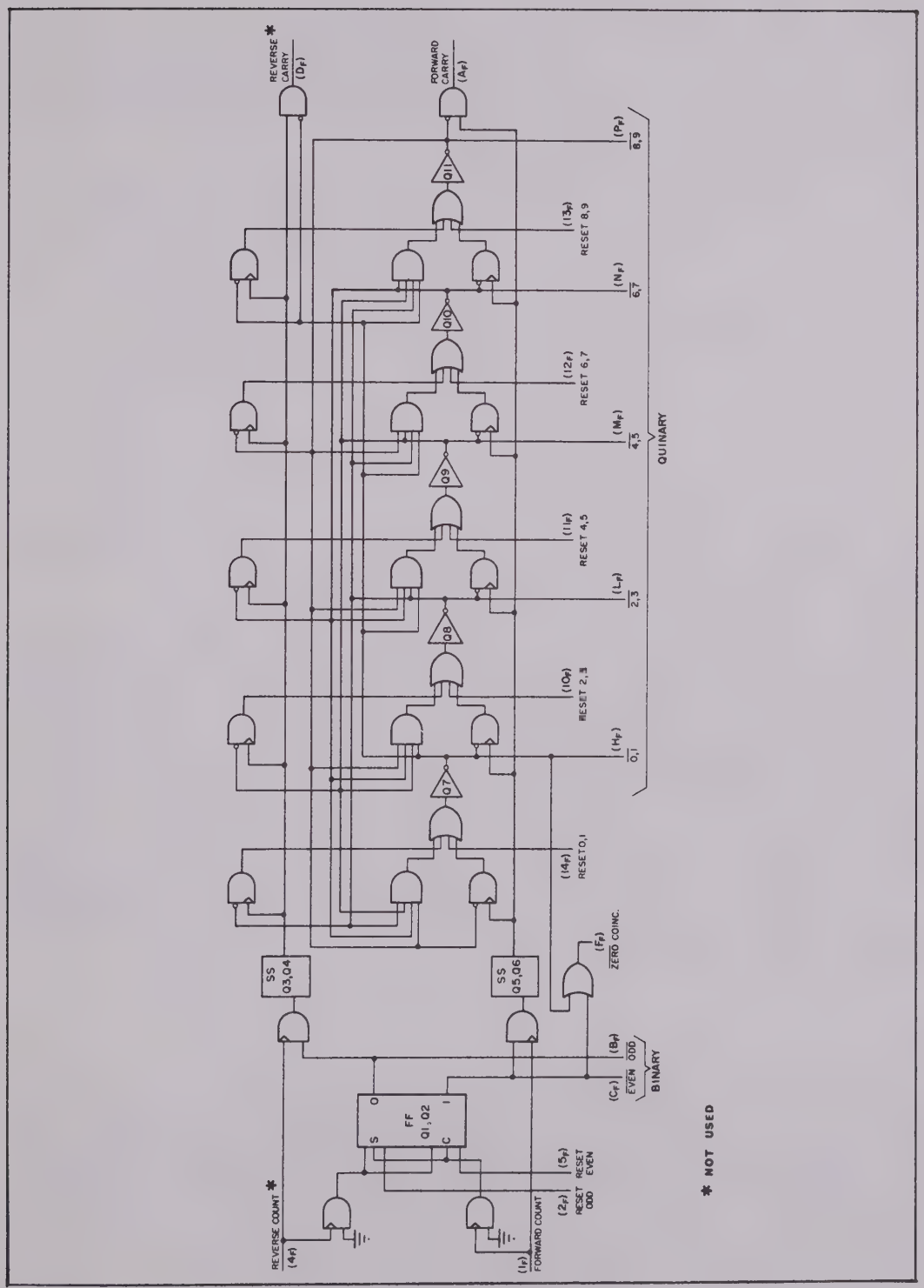


Fig. 3-13. Forward Decimal Counting Unit Logic Diagram

3.12.2 Latch-Follow Control

Storage circuitry is used with the readout DCU's. Data present in the readout DCU's is transferred to storage during the "data set" interval. Following the transfer period, the data is stored and displayed ("latched") until the next data transfer period.

Latch or follow control is accomplished with specific combinations of voltage on control lines 1 and 2. These voltage levels are listed in Table 3-2.

Table 3-2. Latch-Follow Control Voltages

	Control Line 1	Control Line 2
Follow	+0.6	+5
Latch	-14	+0.7

These voltages are generated in the Timing Control Board by the data set timer and appear at Pins M_R and N_R, respectively.

The basic storage circuit is shown in Figure 3-14. Assume that the control lines are in "follow", and that one quinary transistor is ON and the other OFF, resulting in Q2 OFF and Q4 ON during the follow period. Then both Q1 and Q3 are biased OFF. When the control lines switch to "latch", Q1 is turned ON but Q3 remains OFF. During "latch", control line 1 drops sufficiently negative to draw current through R2 and R6. Current through R2 is drawn from Q1 while current through R6 is drawn from the base of Q4. Thus, changing from "follow" to "latch" results in maintaining Q2 OFF and Q4 ON regardless of variations at inputs 1 and 2 throughout the latch period. In this way, data can be stored until the next follow period, at which time the control voltages assume values for "follow" and data contained in the quinary transistors can again be transferred to storage.

3.13 PRESET N SWITCH

The Preset selector switch is designed to generate a unique output whenever its associated DCU reaches the preset decimal digit. Outputs from the five switches are connected to an AND gate, the output of which goes to the Preset Output Board. Figure 3-15 is a schematic showing switch operation.

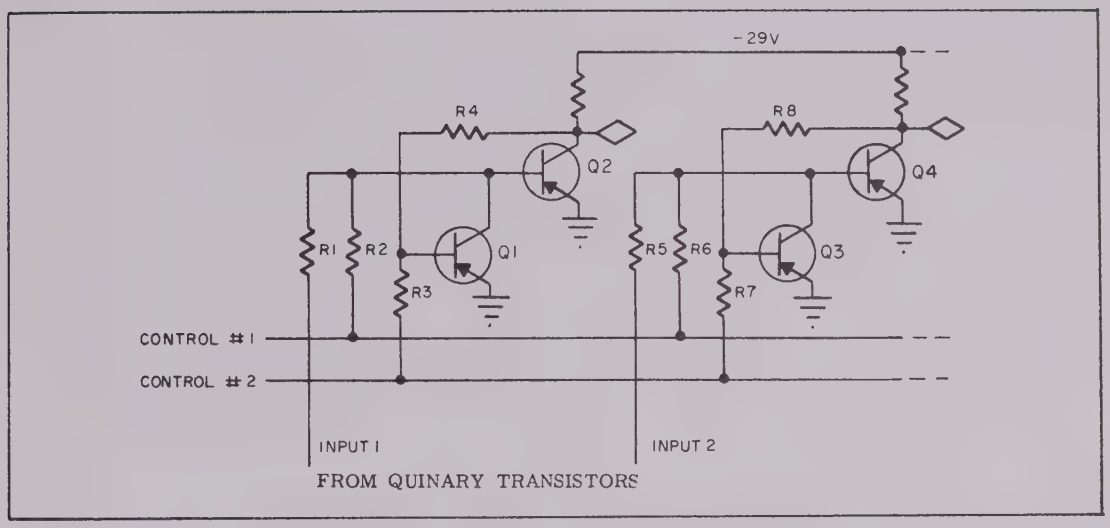


Fig. 3-14. Latch-Follow Storage Circuit

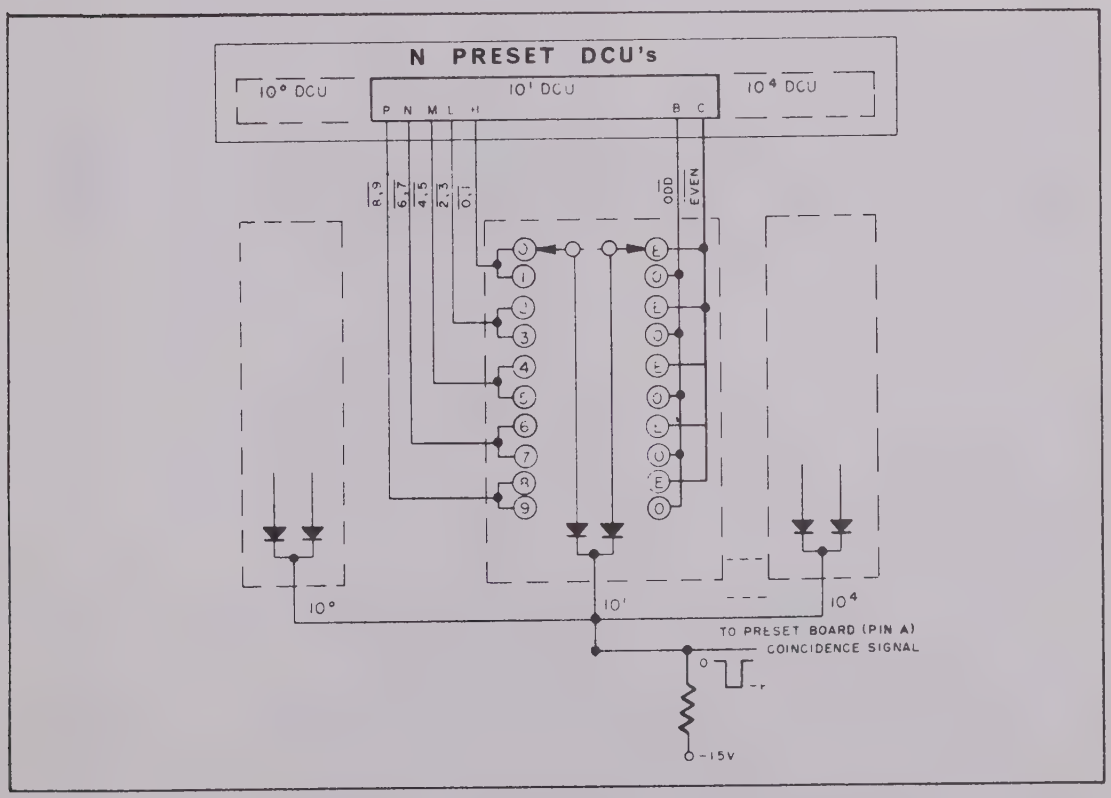


Fig. 3-15. Preset Switch Schematic

3.14 N-1 LOGIC

The Model 6020 uses N-1 logic, meaning that the particular gates in the function boards are opened on the (N-1)th input pulse, thus insuring instantaneous stop, N accumulate, or reset on the Nth input or following clock pulse.

This is accomplished in the Model 6020 by resetting the N and M DCU banks to "1" instead of "0". For example, if M is 100 and the instrument is operating in RATIO, the M DCU's generate an "M-1" control signal to the RATIO function board on the 99th pulse that is receives. An "accumulate N" signal can then be generated on the next Y input. When the N DCU's reach preset N, a "preset N" signal level is generated to the function board. The stop gate can then be controlled open with the next "N-1" signal. The count gate immediately closes on the next Y input.

A timing diagram illustrating N-1 logic is shown in Figure 3-16. In the illustration, N is chosen to be 2, M to be 10, and the FUNCTION to be RATIO.

3.15 READOUT DISPLAY

The dual decimal outputs and odd-even lines from the readout DCU's are used to select the correct decimal digit in the lamp blocks. A diagram of DCU to lamp block connection is shown in Figure 3-17. For specific information on dual decimal output circuitry from the DCU's, refer to the DCU schematic.

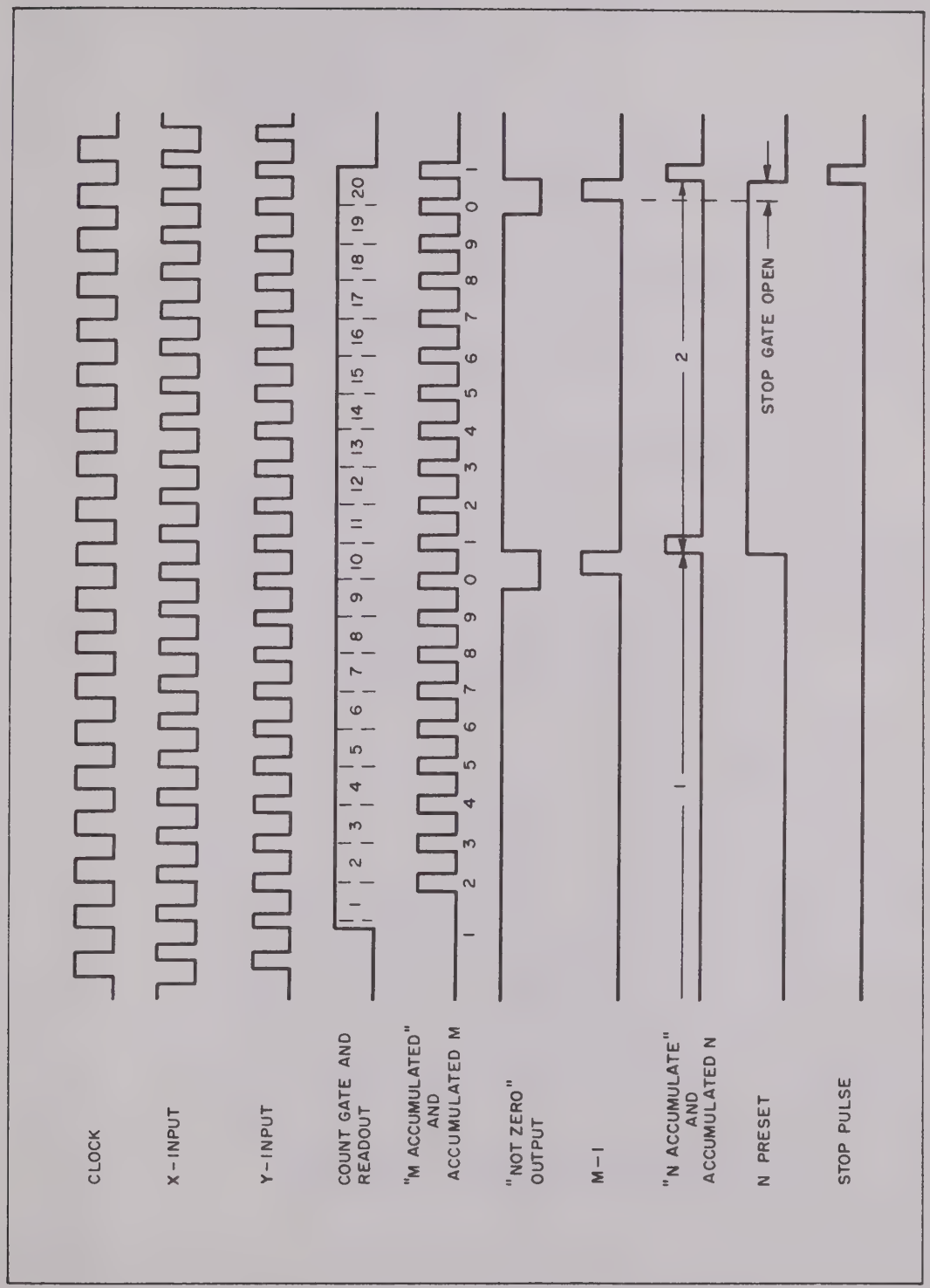

CLOCK
X-INPUT
Y-INPUT
COUNT GATE AND READOUT
"M ACCUMULATED" AND ACCUMULATED M
"NOT ZERO" OUTPUT
M-1
"N ACCUMULATE" AND ACCUMULATED N
N PRESET
STOP PULSE
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
1
2
STOP GATE OPEN

Fig. 3-16. N-1 Logic Timing Diagram

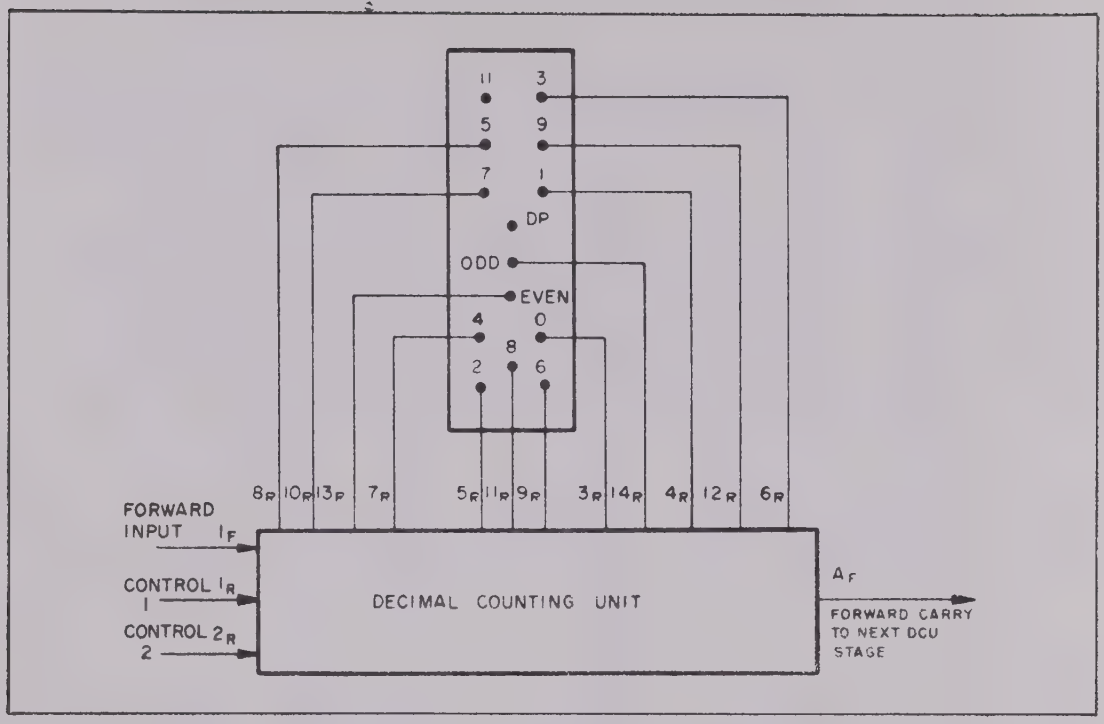


Fig. 3-17. Lamp Block - DCU Interconnection

BAYTRON SYSTEMS CORP.
3303 B-7 Harbor Blvd.
Costa Mesa, Calif. 92626
(714) 557-1682

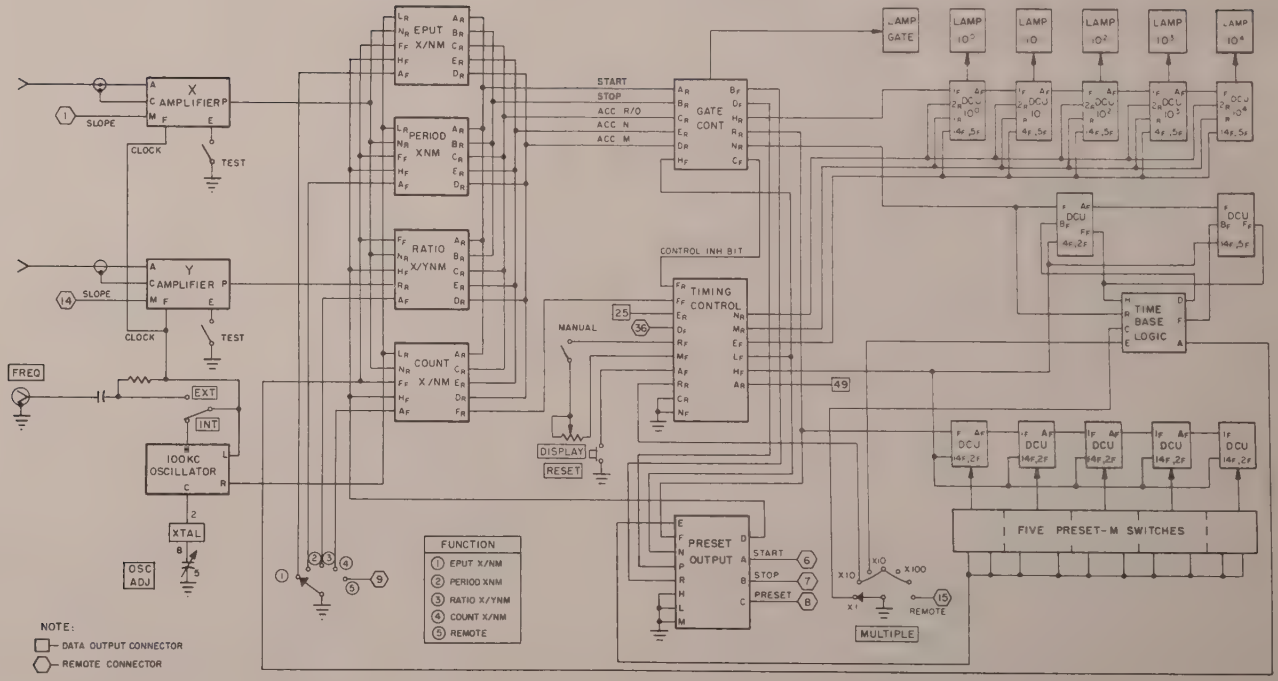


Fig. 3-1. Model 6020 Block Diagram

SECTION 4

SERVICING

4.1 GENERAL

This section provides adjustment procedures and general troubleshooting information for the instrument.

4.1.1 Recommended Test Equipment

Table 4-1 lists the specifications for test instruments used in servicing the instrument. Other instruments may be used if their specifications meet or exceed the listed specifications.

Table 4-1. Recommended Test Equipment

Instrument	Specifications
Oscilloscope	50 mc bandwidth; 3.5 nanosecond rise time.
Signal Generator	1 cps to 100 kc; 1 volt rms output. 100 kd to 2 mc; 1 volt rms output.
Volt-ohmmeter	100 k ohms 1 volt dc.
Auto Transformer	0-130 volts ac, 60 cps.

4.1.2 Board Layout

Use the drawing on the inside top cover of the instrument to locate boards on the main chassis. Components on particular printed circuit boards are located using the board layout drawings included in the rear of the manual.

4.1.3 Extender Boards

Two extender boards have been furnished with the instrument to provide easy access to components and test points on printed circuit boards during operation.

4.2 ADJUSTMENTS

4.2.1 Power Supply Adjustments

The regulated power supply adjustments are located on the regulator board (Figure 4-2).

Power supply test points are located on the underside of the chassis along a horizontal terminal strip. Use Figure 4-2 to locate power supply test points. Wires from these test points are color coded as follows: RED +15 V., GREEN -15 V., YELLOW -29 V.,

4.2.1.1 Adjustment Procedure

CAUTION

Do not remove the regulator board from its receptable without first unplugging the ac line cord from its power source.

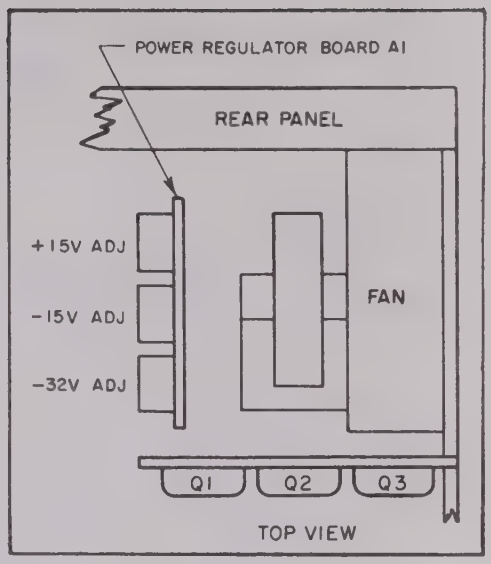


Fig. 4-1. Location of Power Supply Adjustment

1) Use a voltmeter of at least 1% accuracy. Voltage measurements are referenced to chassis ground.

2) Use Figure 4-2 to locate power supply test points.

3) Adjust +15 V terminal to +15 volts, ±0.2 volt.

4) Adjust -15 V terminal to -15 volts, ±0.2 volt.

5) Adjust -29 V terminal to approximately -29 volts.

4.2.2 Triggering Level Adjustment

Triggering level adjustment and test points are on the amplifier board and are accessible from the top of the instrument. There are two test points marked on the board: LEVEL and TEST. Voltage appearing at LEVEL is the actual triggering level, or value which the input voltage must exceed in order to trigger the input circuit. Voltage appearing at TEST is the actual amplifier output.

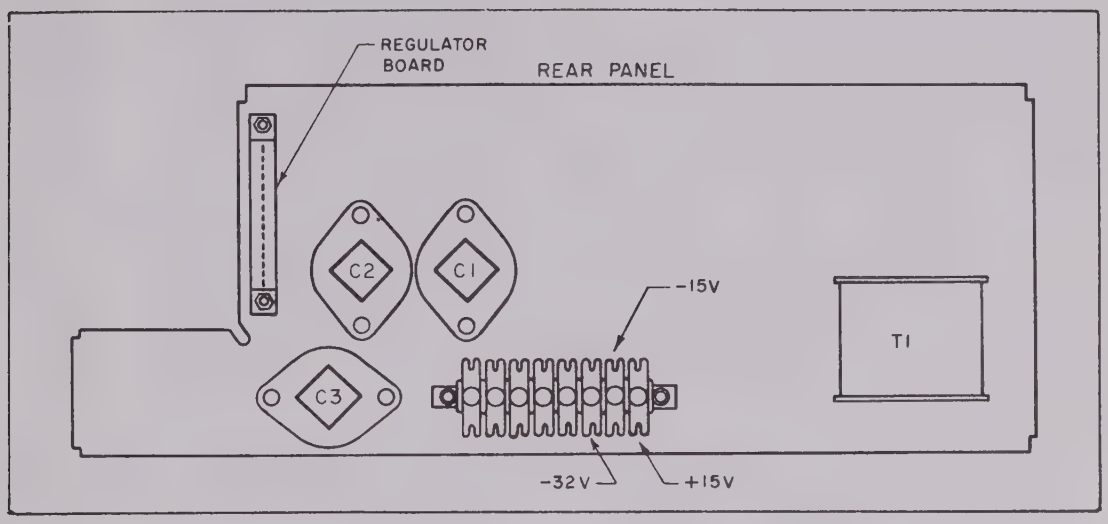


Fig. 4-2. Location of Power Supply Test Points

4.2.2.1 Adjustment Procedure

1) Connect voltmeter of at least 1% accuracy to LEVEL and oscilloscope to TEST.

2) Connect signal generator amplifier input. Using a 100kc signal, set the rms voltage to the desired level.

3) Using the potentiometer mounted on the amplifier board, adjust the discriminator for desired sensitivity. Maximum sensitivity is indicated by the appearance of an output pulse train with approximately 50% duty cycle.

4) Actual triggering level (plus hysteresis) is indicated by the dc voltmeter. A reading of approximately 0 volts indicates maximum sensitivity.

4.2.3 Oscillator Adjustment

Adjustment of the oscillator frequency is seldom necessary. Oscillator adjustment and test points are located on the rear panel as shown in Figure 4-3.

4.2.3.1 Procedure

When adjustments are necessary, use the following procedure:

1) Use Figure 4-3 to locate oscillabor adjustment (FREQ. ADJ.) and test point (J5).

2) Connect an oscilloscope or frequency counter to J5. If an oscilloscope is used, its input impedance must not affect oscillator frequency.

3) With the EXT-INT switch in the INT position, use the FREQ. ADJ. to adjust oscillator frequency to 100 kc.

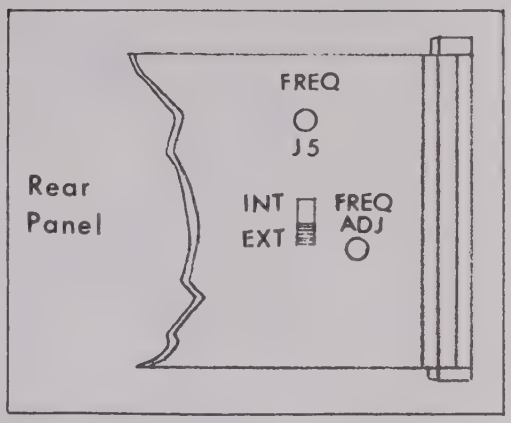


Fig. 4-3. Rear Panel Oscillator Adjustment and Connector

4.3 TROUBLESHOOTING

4.3.1 General

Most circuits in the instrument are mounted on printed circuit boards which can be removed and replaced easily. Troubleshooting may be greatly simplified by replacing boards suspected of being faulty with spare boards which are known to be in good working order. Once the faulty board is identified, it can be repaired and returned to operation.

4.3.2 Replacing Components on Printed Circuit Boards

To prevent damage to the printed circuit board and its components, use heat sparingly and work carefully. Follow this procedure for removing a defective component.

1) Melt solder in the component lead holes and tap board gently to remove solder around component leads.

2) Straighten component leads with long-nose pliers or soldering aid.

3) Remove defective component.

4) If component cannot be removed, reheat leads slightly.

To install a new component follow this procedure.

1) Clean lead holes thoroughly.

2) Cut and bend component leads to proper length and shape.

3) Insert leads into holes and solder into place.

NOTE

When installing transistor or diode, use a heat sink to prevent excessive heat conduction through the component. Long-nose pliers applied between the component and soldering iron make an effective heat sink.

4.3.3 General Troubleshooting

Troubles can often be isolated to an individual circuit board by observing front panel indications in the various operating modes. The wiring diagram included in the rear of the manual will also be useful.

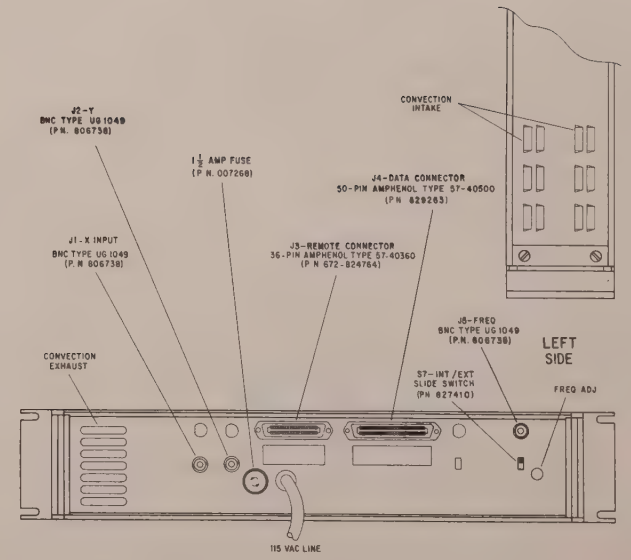
When the faulty board has been located, some of the idealized waveforms and voltage levels given in Section 3 may be helpful in locating the problem. General troubleshooting is facilitated by combined use of logic diagrams given in Section 3 and individual board schematics included in the back of the manual.

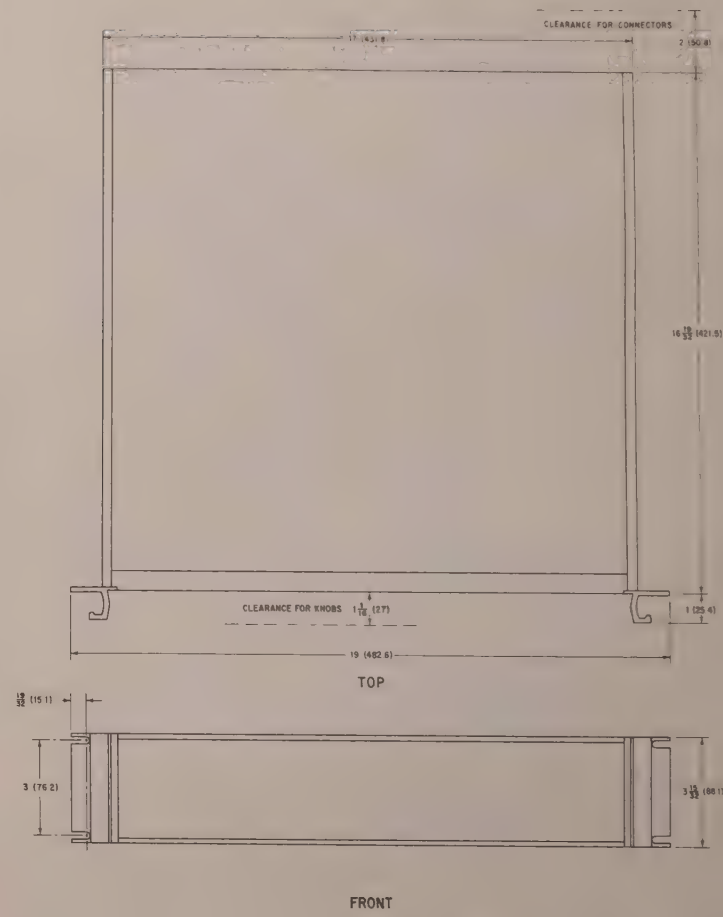
MISCELLANEOUS PARTS
(Models 6020A & 6030A)

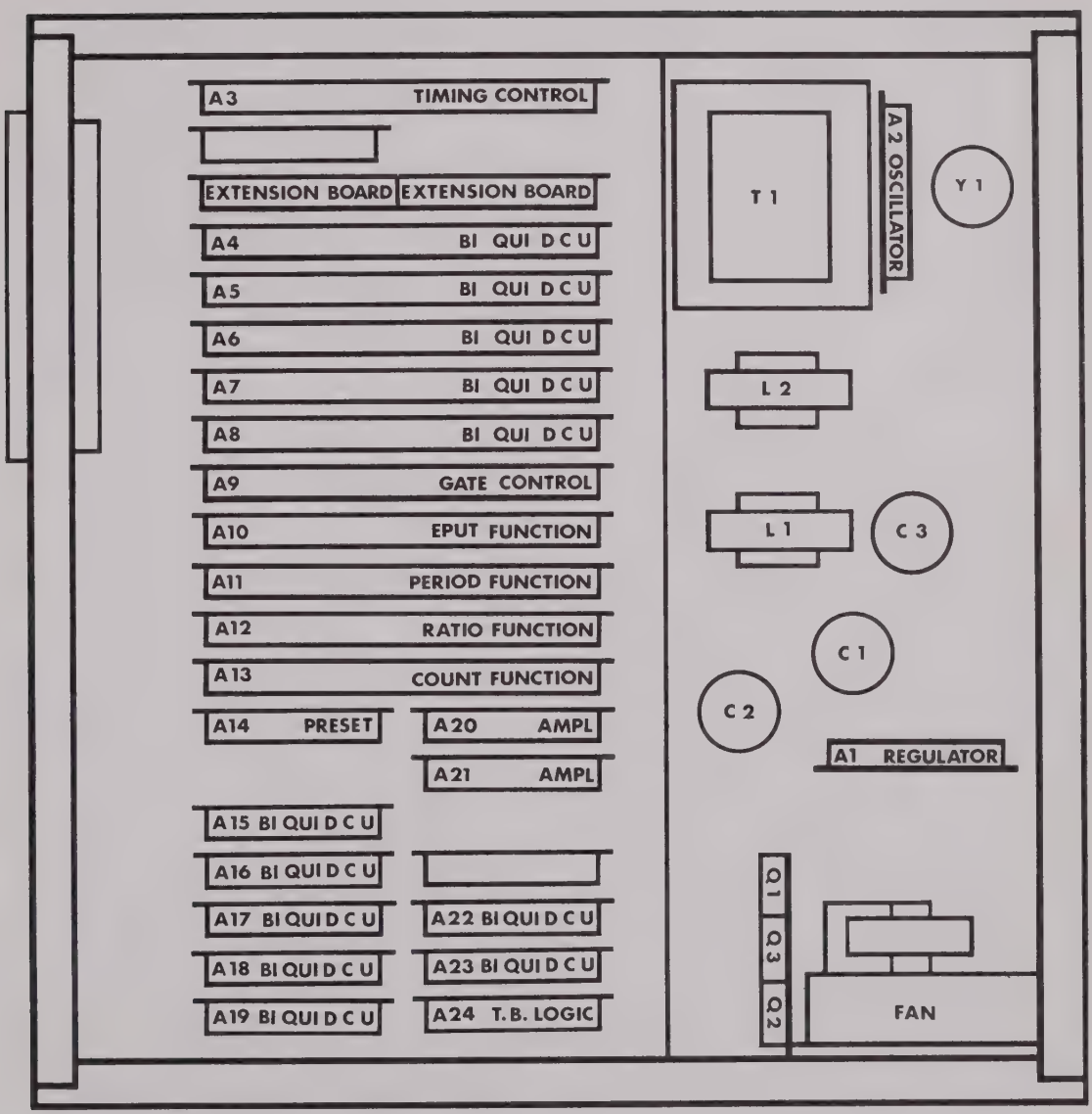
Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
C4	655-824658	Capacitor, V. Glass, 0.6-14 pf, 1000V	JFD Elect., UC11GRA-DL	1
C5	633-804717	Capacitor, F. Cerm., 0.01μf, 500V	Sprague 29C9B5	1
*C6 (C3 in 6030A)	633-812052	Capacitor, F. Cerm., 56 pf, 600V	Erie NPO-337-560J	1
C8, 9, 10, 11 (C6, 7, 8, 9)	633-857033	Capacitor, 2000 pf, 600V, 10%	Skottie TXD-4-202K	4
(CR1 thru 10)	755-420893	Diode, Special	Beckman	10
E3	691-836659	Terminal Strip	Kulka 599-2 W/599-3/4	1
DS1	824-834669	Lamp, Plug-in	Eldema CF2-CC-1762	1
F1	731-801567	Fuse, Elec., 1.5 Amp, 125V, Time Delay	Littelfuse MDL313	1
J1, 2, 5	670-806738	Connector, Coaxial, Receptacle, BNC	Amphenol UG-1094/U	3
J3	672-824764	Connector, Receptacle, 36 pins, Chassis Mtg.	Amphenol 57-40360	1
J4	672-814649	Connector, 50 Female	Amphenol 57-40500	1
	680-823481	Connector, P.C., 15 Contacts	Cinch Mfg. 250-15-30-170	18
	680-824115	Connector, P.C., 15 Contacts	Cinch 251-15-30-160 (19)	20
P3	672-824765	Plug, 36 pin	Amphenol 57-30360	1
R1 (R5)	601-822371	Resistor, F. Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	1
R2 (R4)	601-822326	Resistor, F. Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	1
R3 (R9)	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	1
R4 (R8)	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	1
R5 (R7)	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	1
(R6)	601-823397	Resistor, F. Comp., 5.6K, 1/4W, 5% (on BCD Cable)	Allen Bradley CB5625	1
(S1)	711-425471	Switch, Rotary (Mode)	Beckman	1
(S2)	711-425918	Switch, Rotary (Function)	Beckman	1
(S3)	614-425910	Switch, (Display)	Beckman	1
(S4)	716-838151	Switch, Pushbutton (Reset)	Dialco 513-0101-604	1
(S5)	711-426482	Switch, (Mult.)	Beckman	1
S7	716-827410	Switch, Slide, DPDT	Continental Type 126 (C-W)	1
	716-838206	Switch, 5 Station	EECO 26S-5	1
	711-837930	Switch, Thumbwheel, 2-Pole, Bi-Qui	Engineering Electronics A188425A	5
	716-838152	Lens Cap for Pushbutton Switch, White	Dialco 185-1875	1
XF1	735-007268	Fuseholder, 15 Amp at 250V Breakdown	Bussman HKP	1
XDS1	824-813501	Socket, Lamp Cartridge Mtg.	Dialco 7538	1
Y1	881-401955	Crystal	Beckman	1
	325-420982	Knob, Round, Skirted	Beckman	3
	325-420983	Knob, Round	Beckman	1
	330-420770	Handle	Beckman	2
	664-812450	Cordset, Elect., Power, 3 Cond., Blk, 6 ft.	Cornish	1
	662-426582	Cable, Remote	Beckman	1
	662-426588	Cable, BCD	Beckman	1
	661-427171	Cable, Power	Beckman	1
	885-431044	Resistor Module	Beckman	5
	751-841251	Tube, Nixie (part of Readout Assembly – 855-427088)	Burroughs B85991	5

*Items in parentheses apply to Model 6030A.

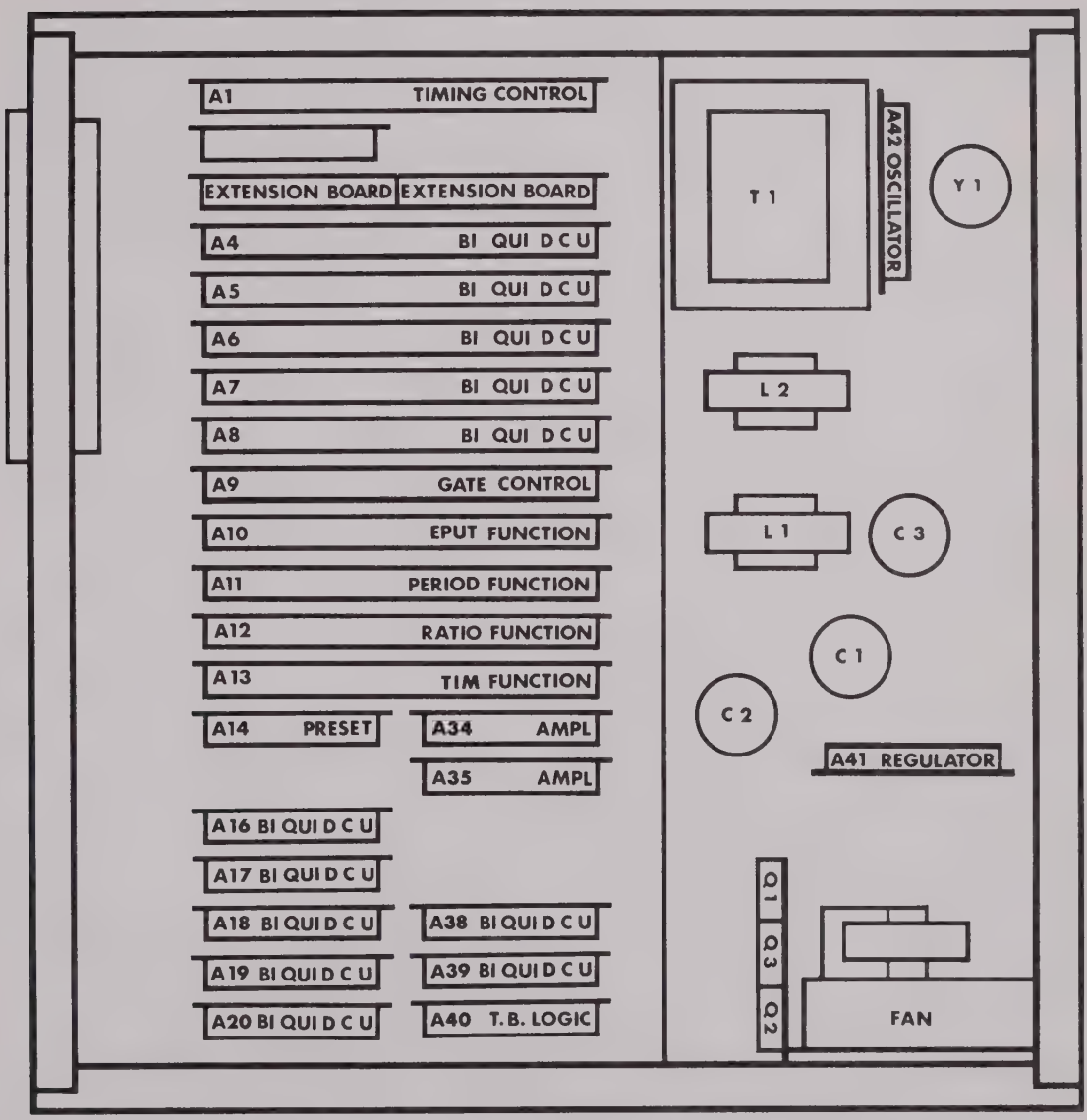
OUTLINE DRAWING







Beckman® MODEL 6020A PRESET EPUT



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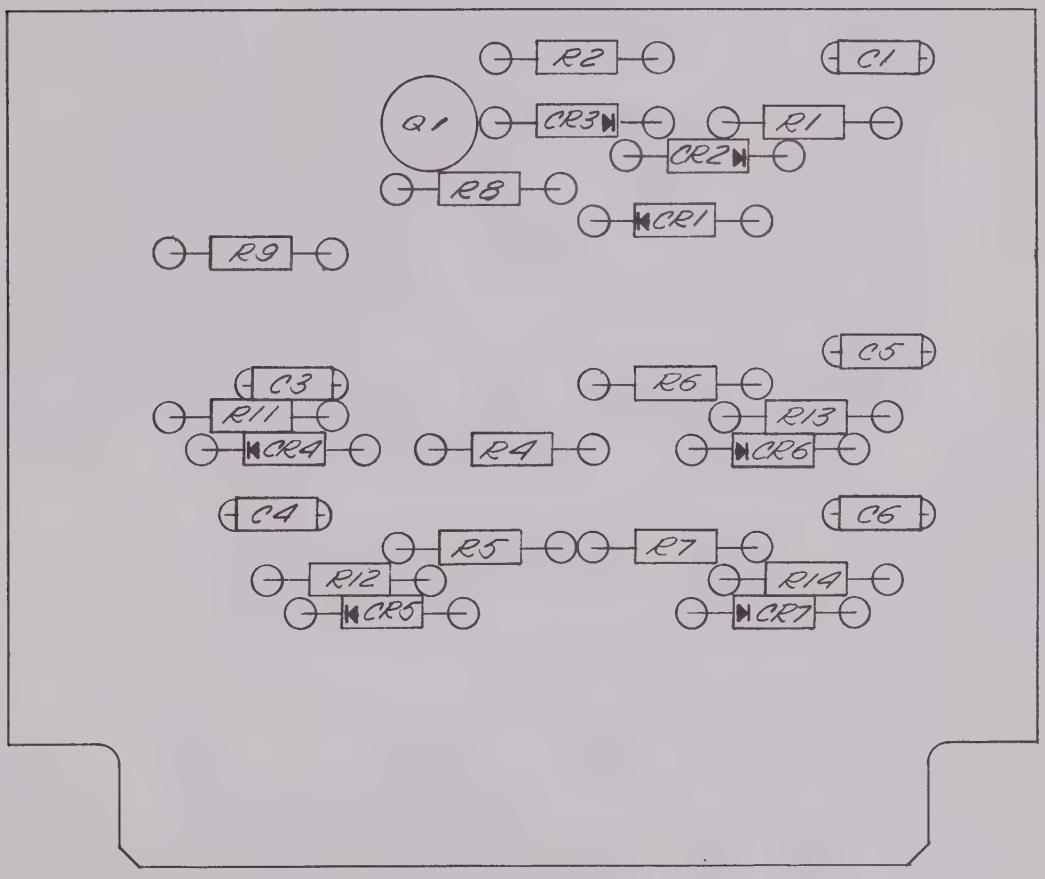


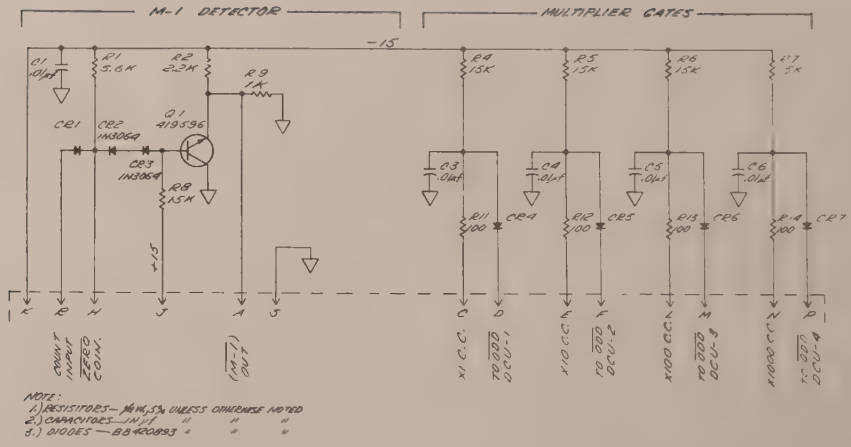
TIME BASE LOGIC BOARD COMPONENT LAYOUT

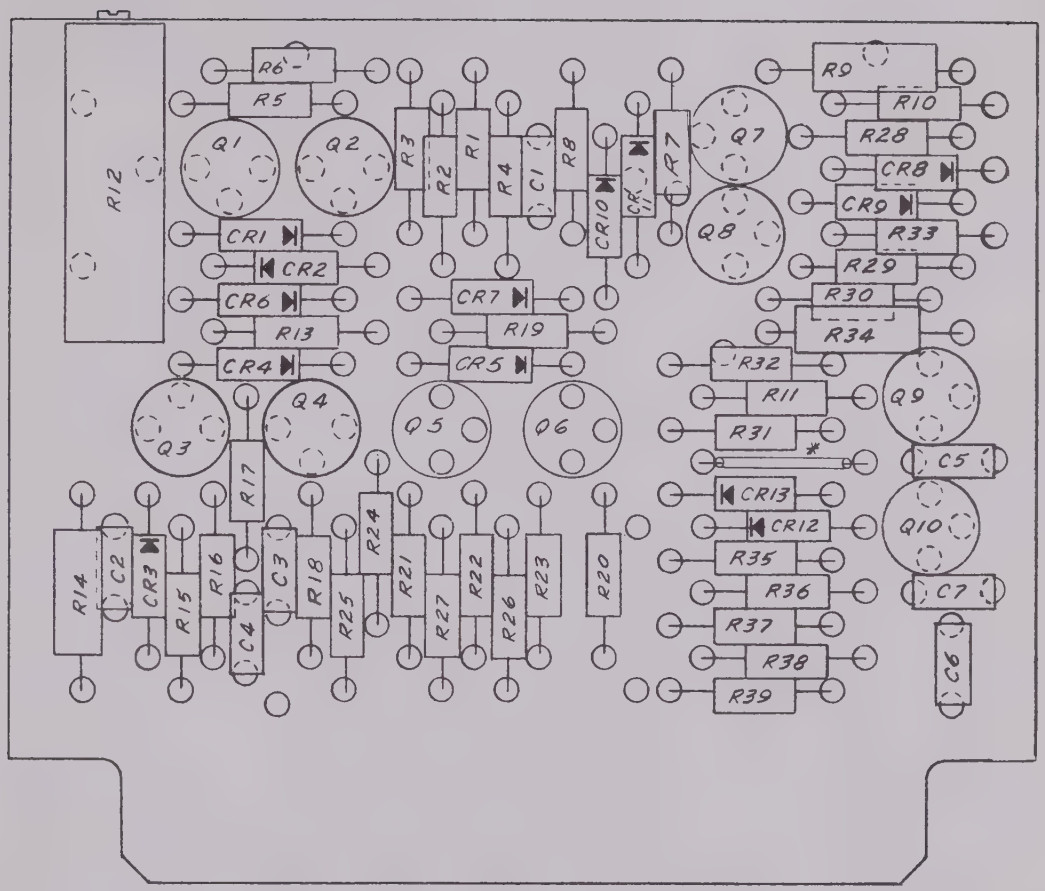
(Model 6020A: A24)
(Model 6030A: A40)

TIME BASE LOGIC BOARD (A24*)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty. / Ass'y
A24	887-424721(B)	Time Base Logic Board	Beckman	1
C1, 3, 4, 5, 6	633-836864	Cap., 0.01 μf, 50V	Sprague 19C214A6	5
CR1, 4, 5, 6, 7	755-420893	Diode, Special	Beckman	5
CR2, 3	755-431324	Diode, Special	Beckman	2
Q1	755-419596	Transistor, Special	Beckman	1
R1	601-823397	Resistor, F.Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	1
R2	601-822328	Resistor, F.Comp., 2.2K, 1/4W, 5%	Allen Bradley CB2225	1
R4 thru 8	601-822301	Resistor, F.Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	5
R9	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	1
R11 thru 14	601-817735	Resistor, F.Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	4

*A24: Model 6020A only. Designation is changed to A40 for Model 6030A.


M-1 DETECTOR
MULTIPLIER GATES
-15
C1 .01μf
R1 5.6K
R2 2.2K
R9 1K
CR1
CR2 IN3064
Q1 419596
CR3 IN3064
R8 1.5K
+15
R4 15K
R5 15K
R6 15K
R7 15K
C3 .01μf
C4 .01μf
C5 .01μf
C6 .01μf
R11 100
R12 100
R13 100
R14 100
CR4
CR5
CR6
CR7
K
B
N
J
A
S
C
D
E
F
M
N
P
ZERO COMP. INPUT
(-) INPUT
X1 O.C.
X10 O.C.
X100 O.C.
X1000 O.C.
X10000 O.C.
NOTE:
1.) RESISITORS — ¼W, 5% UNLESS OTHERWISE NOTED
2.) CAPACITORS — IN μf " " "
3.) DIODES — BB 420893 " " "



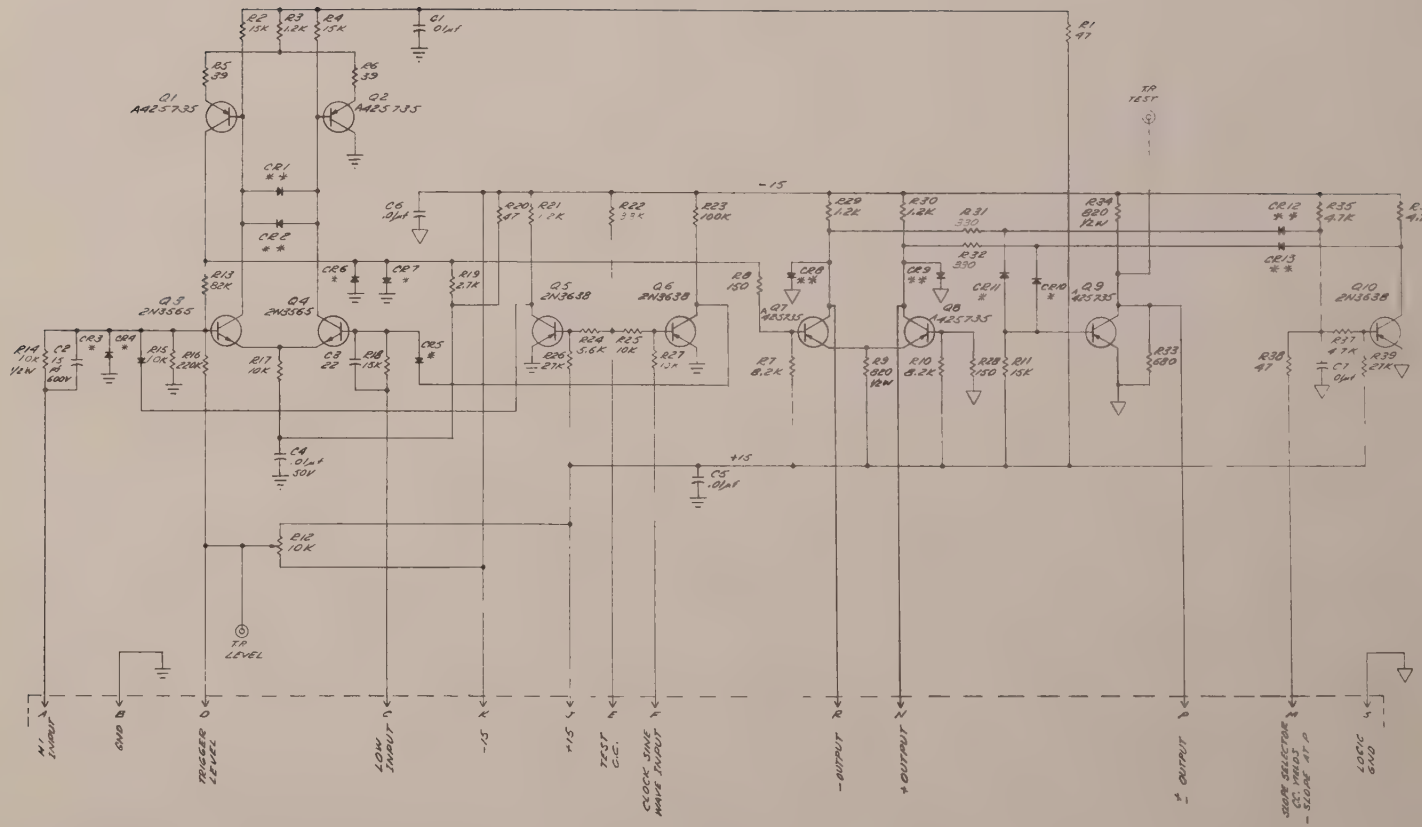
INPUT AMPLIFIER BOARD COMPONENT LAYOUT

(Model 6020A: A20 & A21)
(Model 6030A: A34 & A35)

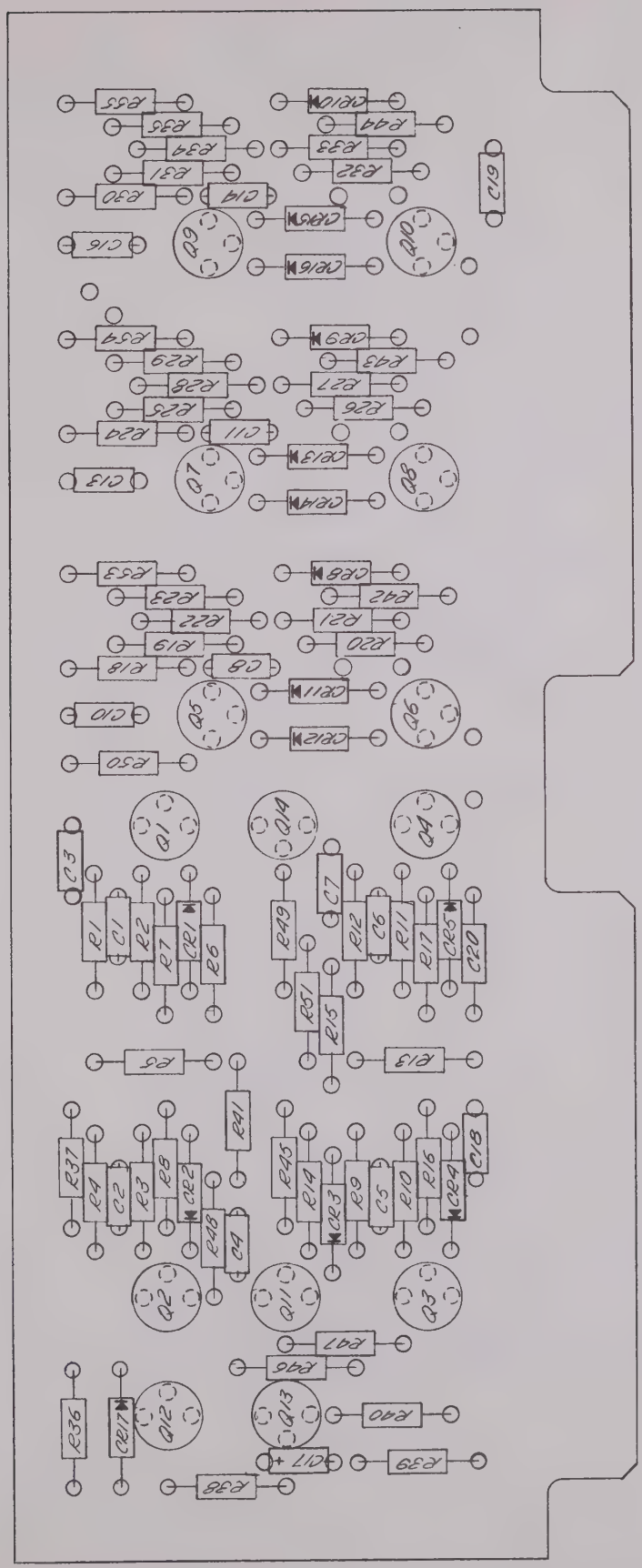
INPUT AMPLIFIER BOARD (A20, A21*)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A20, A21	887-428770 (F)	Imput Amplifier Board	Beckman	2
C1, 4 thru 7	633-836864	Cap., F. Cerm., 0.01uf, 50V	Sprague 19C214A6	5
C2	633-838427	Cap., F. Cerm., 15pf, 500V	Skottie TSD4-150K	1
C3	633-838425	Cap., F. Cerm., 22pf, 500V	Skottie TSD4-220K	1
CR1, 2, 8, 9, 12, 13	755-420893	Diode, 893	Beckman	6
CR3, 4, 5, 6, 7, 10, 11	755-431324	Diode, Special	Beckman	7
Q1, 2, 7, 8, 9	755-425735	Transistor, Special	Beckman	5
Q3, 4	755-838784	Transistor, 2N3565	Fairchild	2
Q5, 6, 10	755-838105	Transistor, 2N3638	Fairchild	3
R1, 20, 38	601-823387	Resistor, F. Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	3
R2, 4, 11, 18	601-822301	Resistor, F. Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	4
R3, 21, 29, 30	601-822326	Resistor, F. Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	4
R5, 6	601-823386	Resistor, F. Comp., 39Ω, 1/4W, 5%	Allen Bradley CB3905	2
R7, 10	601-822331	Resistor, F. Comp., 8.2K, 1/4W, 5%	Allen Bradley CB8225	2
R8, 28	601-823391	Resistor, F. Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	2
R9, 34	601-079172	Resistor, F. Comp., 820Ω, 1/2, 5%	Allen Bradley EB8215	2
R12	611-826874	Resistor, Var., W.W., 10K	Bourns 3067P-1-1-3	1
R13	601-822543	Resistor, F. Comp., 82K, 1/4W, 5%	Allen Bradley CB8235	1
R14	601-015052	Resistor, F. Comp., 10K, 1/2W, 5%	Allen Bradley EB1035	1
R15, 17, 25, 27	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	4
R16	601-823908	Resistor, F. Comp., 220K, 1/4W, 5%	Allen Bradley CB2245	1
R19	601-822295	Resistor, F. Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	1
R22	601-822296	Resistor, F. Comp., 3.3K, 1/4W, 5%	Allen Bradley CB1045	1
R23	601-823904	Resistor, F. Comp., 100K, 1/4W, 5%	Allen Bradley CB1045	1
R24	601-823397	Resistor, F. Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	1
R26, 39	601-822335	Resistor, F. Comp., 27K, 1/4W, 5%	Allen Bradley CB2735	2
R31, 32	601-823394	Resistor, F. Comp., 330Ω, 1/4W, 5%	Allen Bradley CB3315	2
R33	601-822369	Resistor, F. Comp., 680Ω, 1/4W, 5%	Allen Bradley CB6815	1
R35, 36, 37	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	3

*A20, 21: Model 6020A only.
Designations are changed to A34 and A35, respectively, for Model 6030A.



NOTE:
1. RESISTORS: 1/8 W, 5% UNLESS OTHERWISE NOTED.
2. * DIODES ARE BIT A795-431328.
3. ** DIODE, BECKMAN, A795-420893.

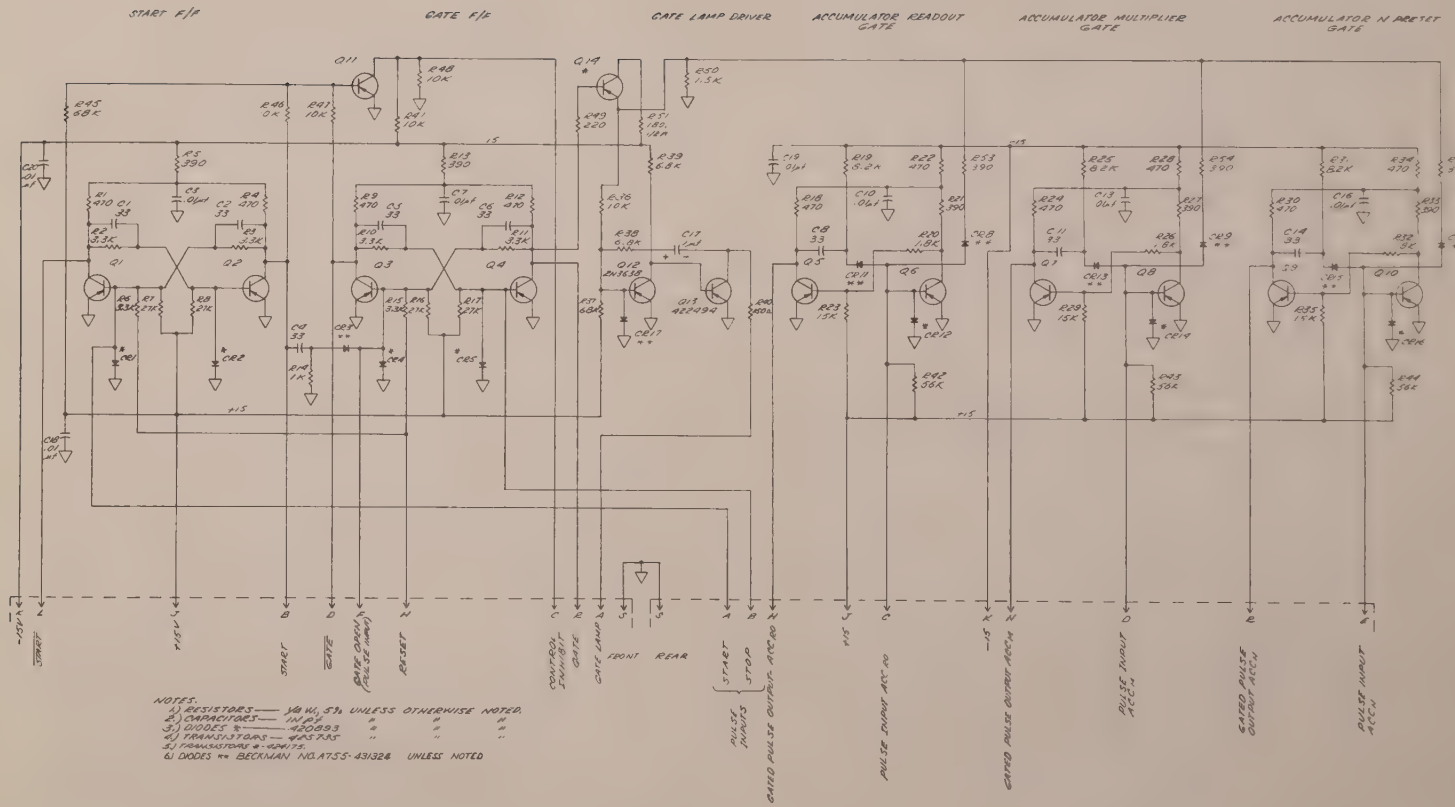


GATE CONTROL BOARD COMPONENT LAYOUT (A9)

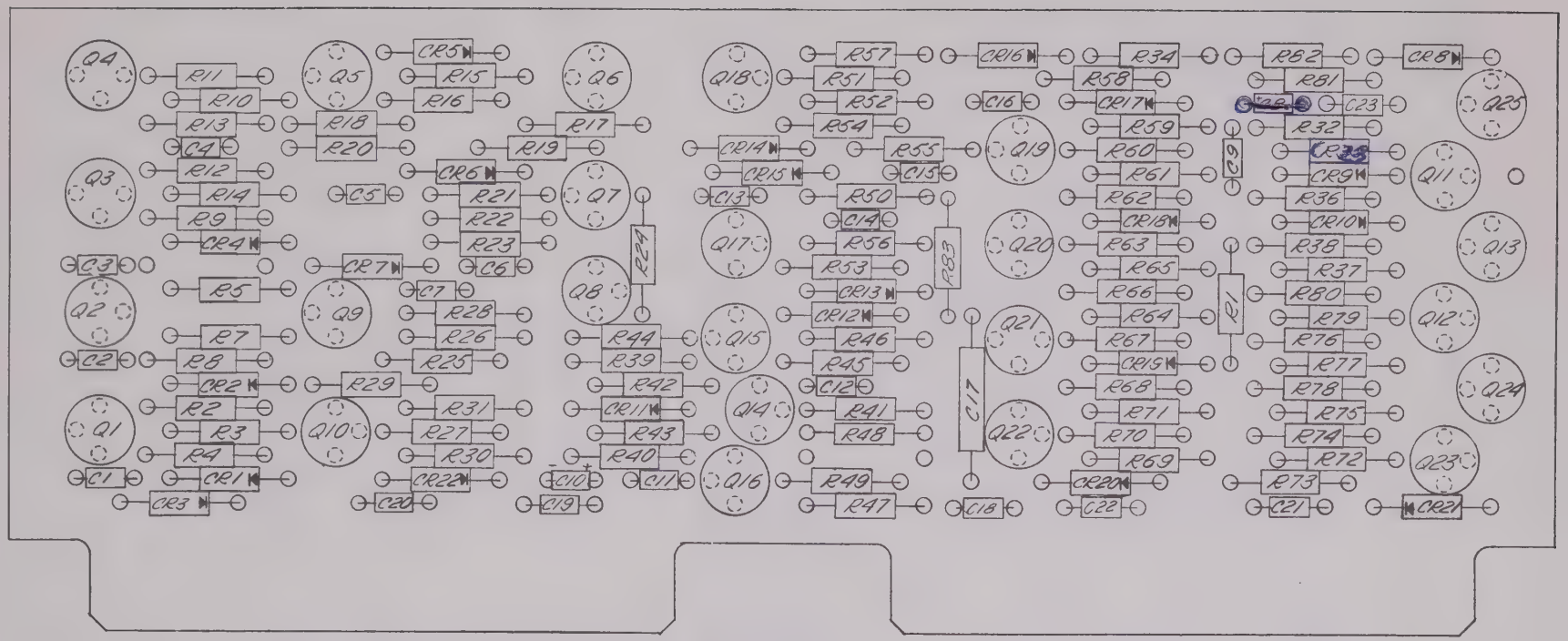
GATE CONTROL BOARD (A9)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A9	887-425446 (E)	Gate Control Board	Beckman	1
C1, 2, 4, 5, 6, 8, 11, 14	633-838426	Cap., 33pf, 500V, 10%	Skottie TSD4-300-K	8
C3, 7, 10, 13, 16, 18, 19, 20	633-836864	Cap., 0.01μf, 50V	Sprague 19C214A6	8
C17	631-844520	Cap., 1μf, 35V, 20% Tant.	Kemet K1P35	1
CR1, 2, 4, 5, 12, 14, 16	755-420893	Diode, Special	Beckman	7
CR3, 8, 9, 10, 11, 13, 15, 17	755-431324	Diode, Special	Beckman	8
Q1 thru 11	755-425735	Transistor, Special	Beckman	11
Q12	755-838105	Transistor, 2N3638	Fairchild	1
Q13	755-422494	Transistor, Special	Beckman	1
Q14	755-424175	Transistor, Special	Beckman	1
R1, 4, 9, 12, 18, 22, 24, 28, 30, 34	601-823395	Resistor, F.Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	10
R2, 3, 6, 10, 11, 15	601-822296	Resistor, F.Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	6
R5, 13, 21, 27, 33, 53, 54, 55	601-822371	Resistor, F.Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	8
R7, 8, 16, 17	601-822335	Resistor, F.Comp., 27K, 1/4W, 5%	Allen Bradley CB2725	4
R14	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	1
R19, 25, 31	601-822331	Resistor, F.Comp., 8.2K, 1/4W, 5%	Allen Bradley CB8225	3
R20, 26, 32	601-822544	Resistor, F.Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	3
R23, 29, 35	601-822301	Resistor, F.Comp., 15K, 1/4W, 5%	Allen Bradley CB1525	3
R36, 41, 46, 47, 48	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1015	5
R37, 45	601-822798	Resistor, F.Comp., 68K, 1/4W, 5%	Allen Bradley CB6835	2
R38, 39	601-822299	Resistor, F.Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	2
R40	601-823391	Resistor, F.Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	1
R42, 43, 44	601-823903	Resistor, F.Comp., 56K, 1/4W, 5%	Allen Bradley CB5635	3
R49	601-822327	Resistor, F.Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	1
R50	601-822527	Resistor, F.Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	1
R51	601-024744	Resistor, F.Comp., 180Ω, 1/2W, 5%	Allen Bradley EB1815	1

DATRON SYSTEMS, INC.
3183 Harbor Blvd.
Costa Mesa, Calif. 92626
(714) 557-1682



NOTES.
1.) RESISTORS — ¼ W, 5% UNLESS OTHERWISE NOTED.
2.) CAPACITORS — IN μf " " "
3.) DIODES — 420893 " " "
4.) TRANSISTORS — 443285 " " "
5.) TRANSISTORS # - 424175.
6.) DIODES = BECKMAN NO. AT55-431328 UNLESS NOTED



TIMING CONTROL BOARD COMPONENT LAYOUT

(Model 6020A: A1)
(Model 6030A: A3)

TIMING CONTROL BOARD (A1*)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A1	887-426251 (F)	Timing Control Board	Beckman	1
C1	633-804706	Cap., Cerm., 0.001 μf, 1KV	Centralab DD-102	1
C2	637-819380	Cap., F. Mica, 150pf, 300V	Electromotive SCDM15F151J-300	1
C3, 9	633-857032	Cap., F. Cerm., 0.002μf, 500V	Centralab CF-202	2
C4, 7, 12, 13, 14	633-838426	Cap., F. Cerm., 33pf, 500V	Skottie TSD4-330-K	5
C5	633-838425	Cap., F. Cerm., 22pf, 500V	Skottie TSD4-220-K	1
C6	637-827575	Cap., F. Mica, 18pf, 500V	Electromotive DM15C-180J	1
C8	631-844520	Cap., F. Elect. Tant., 1μf, 35V	Kemet K1P35	1
C10	631-841450	Cap., F. Elect. Tant., 10μf, 25V	Kemet K10T25	1
C11, 18, 19, 20, 21, 22	633-836864	Cap., F. Cerm., 0.01μf, 50V	Sprague 19C214A6	6
C15, 16	633-836932	Cap., F. Cerm., 100pf, 500V	Skottie TSD4-101-K	2
C17	651-836712	Cap., F. Mylar, 0.1μf, 50V	Elpac ZX5A104K	1
C23	633-857080	Cap., F. Cerm., 0.0033μf, 500V	Sprague 19C404A	1
CR1, 4, 7	755-402107	Diode, Special, 1N95	Beckman	3
CR2, 3, 6, 8, 10 thru 21	755-431324	Diode, Special	Beckman	16
CR5, 22	755-420893	Diode, Special	Beckman	2
CR9	755-404593	Diode, Special	Beckman	1
Q1, 2, 3, 4, 7, 8, 17, 18, 19	755-425735	Transistor, Special	Beckman	9
Q5, 9, 20, 23	755-419596	Transistor, Special	Beckman	4
Q6, 10, 13, 24	755-817964	Transistor, 2N1420	PSI	4
Q11, 12, 22, 25	755-838105	Transistor, 2N3638	Fairchild	4
Q14	755-838784	Transistor, 2N3565	Fairchild	1
Q15, 16, 21	755-422494	Transistor, Special	Beckman	3
R1	601-822531	Resistor, F. Comp., 33K, 1/4W, 5%	Allen Bradley CB3335	1
R2, 3, 4, 5, 7, 18, 20, 30, 32, 46, 51, 55, 59, 60, 64, 65, 68, 69, 71, 72, 73, 81	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	22

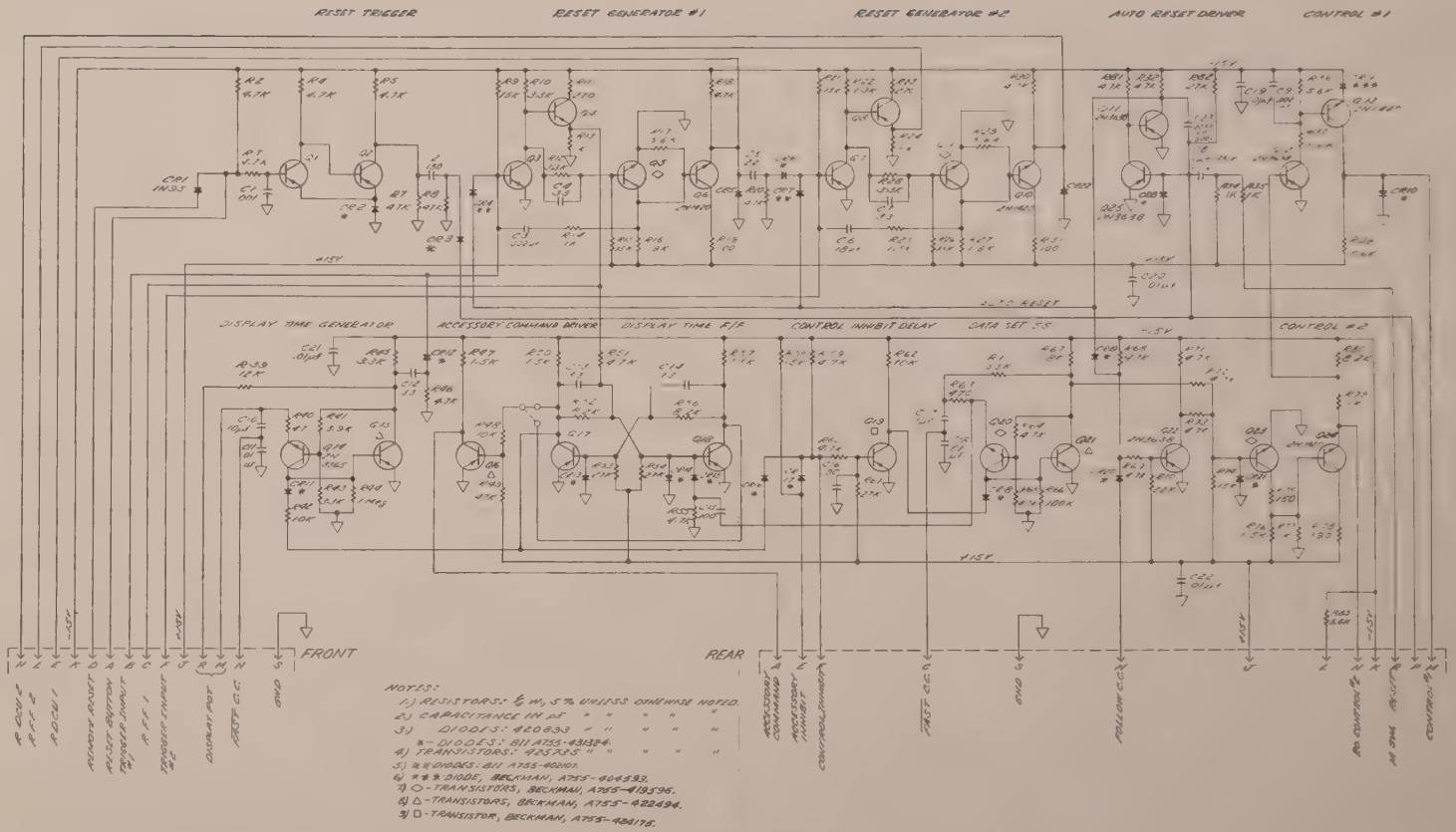
continued. . .

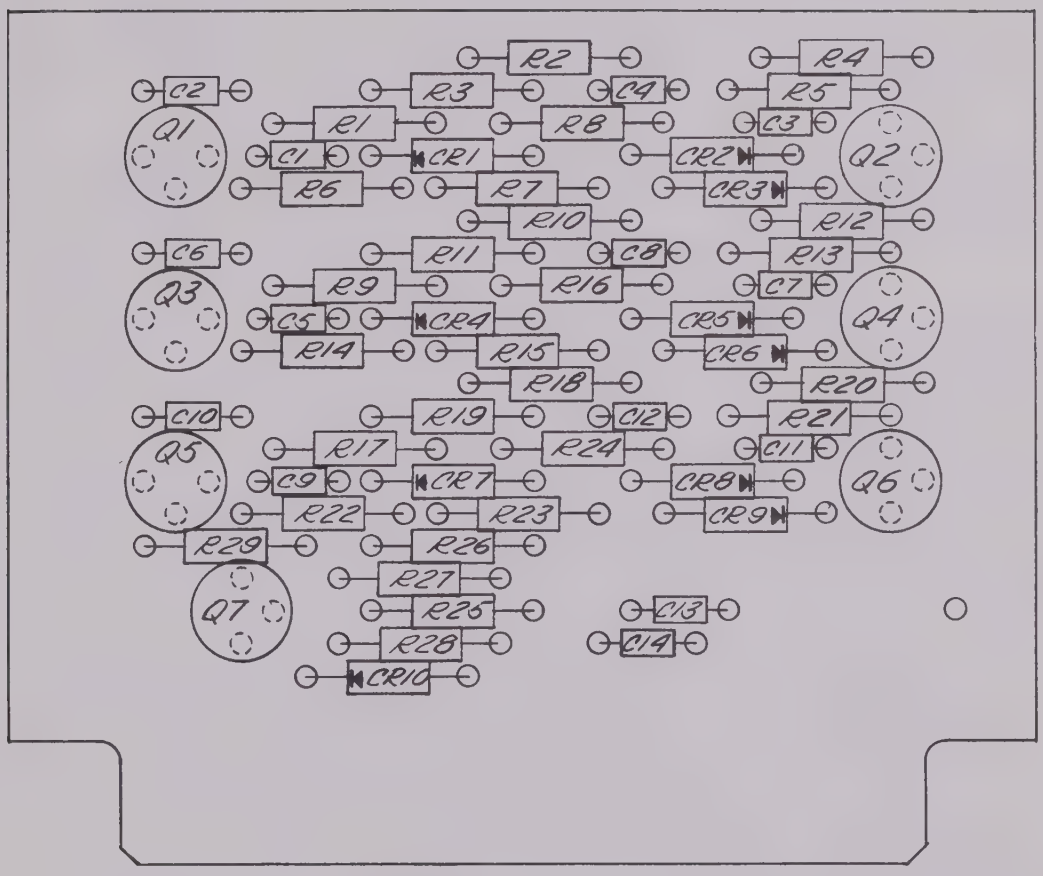
*A1: Model 6020A only. Designation is changed to A3 for Model 6030A.

TIMING CONTROL BOARD (A1) - continued

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
R8, 49	601-823902	Resistor, F.Comp., 47K, 1/4W, 5%	Allen Bradley CB4735	2
R9, 15, 21, 26, 58, 74	601-822301	Resistor, F.Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	6
R10, 12, 22, 28, 43, 45	601-822296	Resistor, F.Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	6
R11, 23	601-823393	Resistor, F.Comp., 270Ω, 1/4W, 5%	Allen Bradley CB2715	2
R13, 14, 24, 34, 35, 77, 79	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	7
R16, 27, 67	601-822544	Resistor, F.Comp., 1.8K, 1/4W, 5%	Allen Bradley CB1825	3
R17, 29, ~~36~~ 37, 38, 83	601-823397	Resistor, F.Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	6
R19, 31	601-817735	Resistor, F.Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	2
R25, 47, 50 57, 76	601-822527	Resistor, F.Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	5
R39	601-801803	Resistor, F.Comp., 12K, 1/4W, 5%	Allen Bradley CB1235	1
R40	601-823387	Resistor, F.Comp., 47Ω, 1/4W, 5%	Allen Bradley CB4705	1
R41	601-822460	Resistor, F.Comp., 3.9K, 1/4W, 5%	Allen Bradley CB3925	1
R42, 48, 62	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	3
R44	601-823916	Resistor, F.Comp., 1M, 1/4W, 5%	Allen Bradley CB1055	1
R52, 56, 80	601-822331	Resistor, F.Comp., 8.2K, 1/4W, 5%	Allen Bradley CB8225	3
R53, 54, 61, 82	601-822335	Resistor, F.Comp., 27K, 1/4W, 5%	Allen Bradley CB2735	4
R63	601-823395	Resistor, F.Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	1
R66	601-823904	Resistor, F.Comp., 100K, 1/4W, 5%	Allen Bradley CB1015	1
R70	601-822334	Resistor, F.Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	1
R75	601-823391	Resistor, F.Comp., 150Ω, 1/4W, 5%	Allen Bradley CB1515	1
R78	601-822371	Resistor, F.Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	1
	864-412958	Pad, Transistor	Beckman	11
	864-832780	Pad, Transistor	Miltonross 10034	14

TIMING CONTROL
SCHEMATIC DIAGRAM



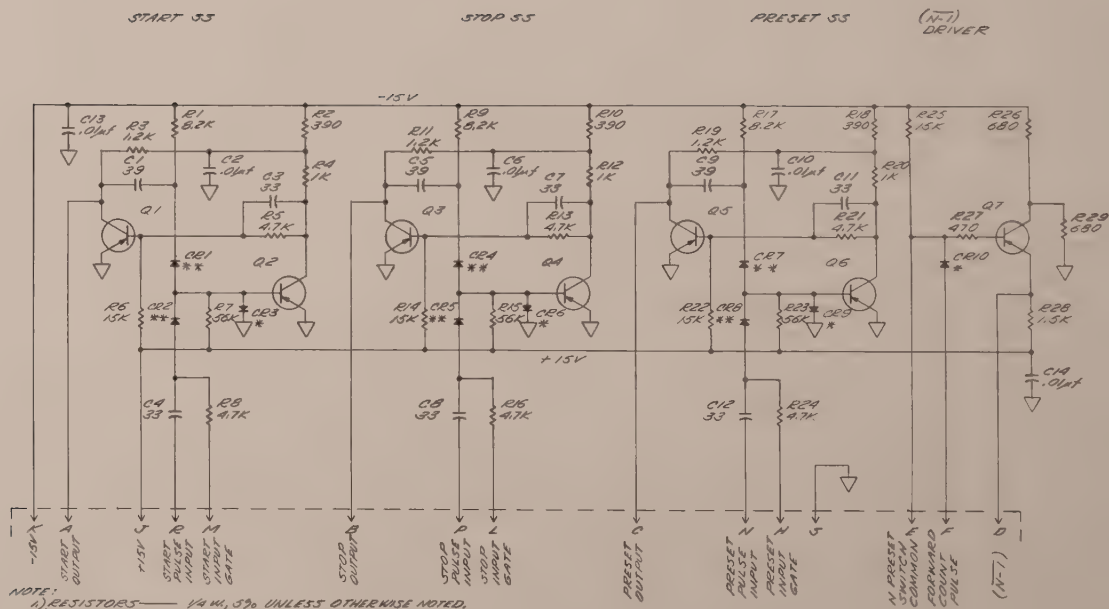


PRESET OUTPUT BOARD COMPONENT LAYOUT (A14)

PRESET OUTPUT BOARD (A14)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A14	887-426432(A)	Preset Output Board (A14)	Beckman	1
C1, 5, 9	633-839570	Cap., 39pf, 500V, 10%	Skottie TSD4-390K-1/2	3
C2, 6, 10 13, 14	633-836864	Cap., 0.01μf, 50V	Sprague 19C214A6	5
C3, 4, 7, 8, 11, 12	633-838426	Cap., 33pf, 500V, 10%	Skottie TSD4-330-K	6
CR1, 2, 4, 5, 7, 8	755-431324	Diode, CD6111	Beckman	6
CR3, 6, 9, 10	755-420893	Diode, Special	Beckman	4
Q1 thru Q7	755-425735	Transistor, Special	Beckman	7
R1, 9, 17	601-822331	Resistor, F.Comp., 8.2K, 1/4W, 5%	Allen Bradley CB8225	3
R2, 10, 18	601-822371	Resistor, F.Comp., 390Ω, 1/4W, 5%	Allen Bradley CB3915	3
R3, 11, 19	601-822326	Resistor, F.Comp., 1.2K, 1/4W, 5%	Allen Bradley CB1225	3
R4, 12, 20	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	3
R5, 8, 13, 16, 21, 24	601-822297	Resistor, F.Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	6
R6, 14, 22, 25	601-822301	Resistor, F.Comp., 15K, 1/4W, 5%	Allen Bradley CB1535	4
R7, 15, 23	601-823903	Resistor, F.Comp., 56K, 1/4W, 5%	Allen Bradley CB5635	3
R26, 29	601-822369	Resistor, F.Comp., 680Ω, 1/4W, 5%	Allen Bradley CB6815	2
R27	601-823395	Resistor, F.Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	1
R28	601-822527	Resistor, F.Comp., 1.5K, 1/4W, 5%	Allen Bradley CB1525	1

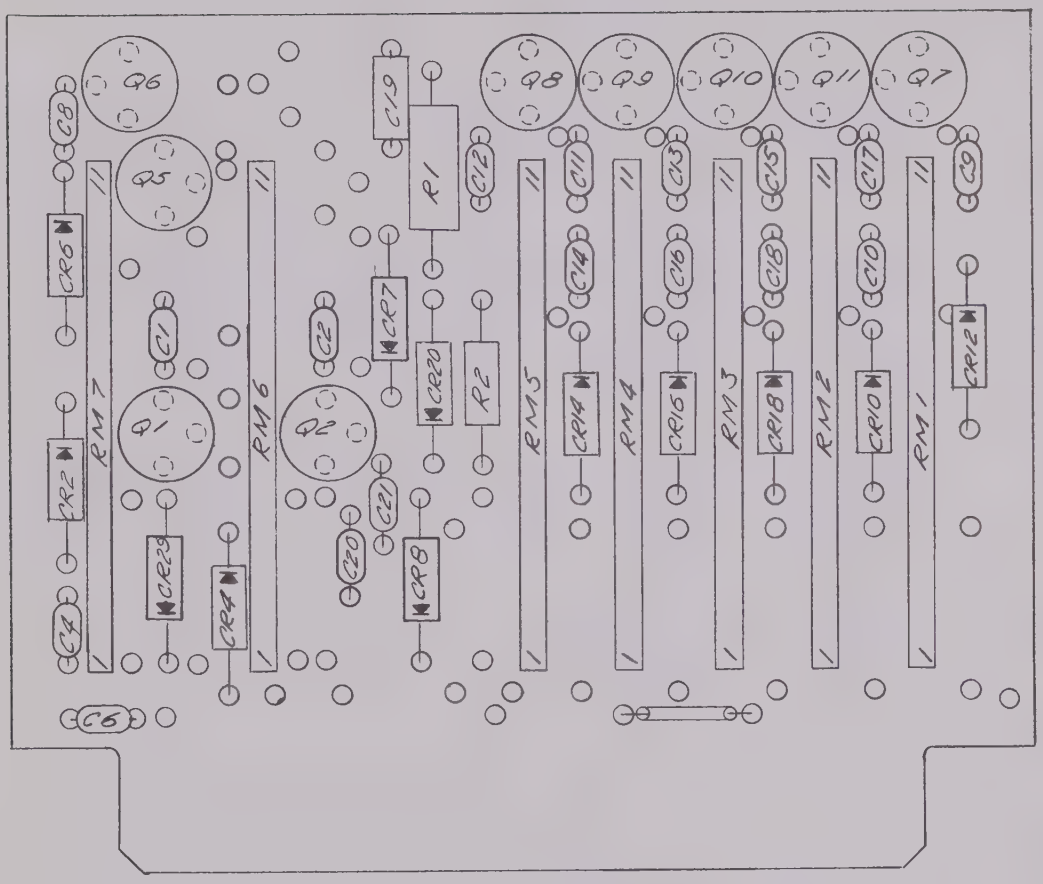
PRESET OUTPUT
SCHEMATIC DIAGRAM



NOTE:
1.) RESISTORS —— 1/4 W, 5% UNLESS OTHERWISE NOTED.
2.) CAPACITORS — IN μf " " "
3.) TRANSISTORS — 425735 " " "
4.) DIODES * —— 420893
DIODES ** —— CD 6111

5020A & 5030A
C 425501-Rev. A
April, 1961

Beckman



BI-QUINARY DCU (FWD. ONLY, wo/READOUT) BOARD
COMPONENT LAYOUT

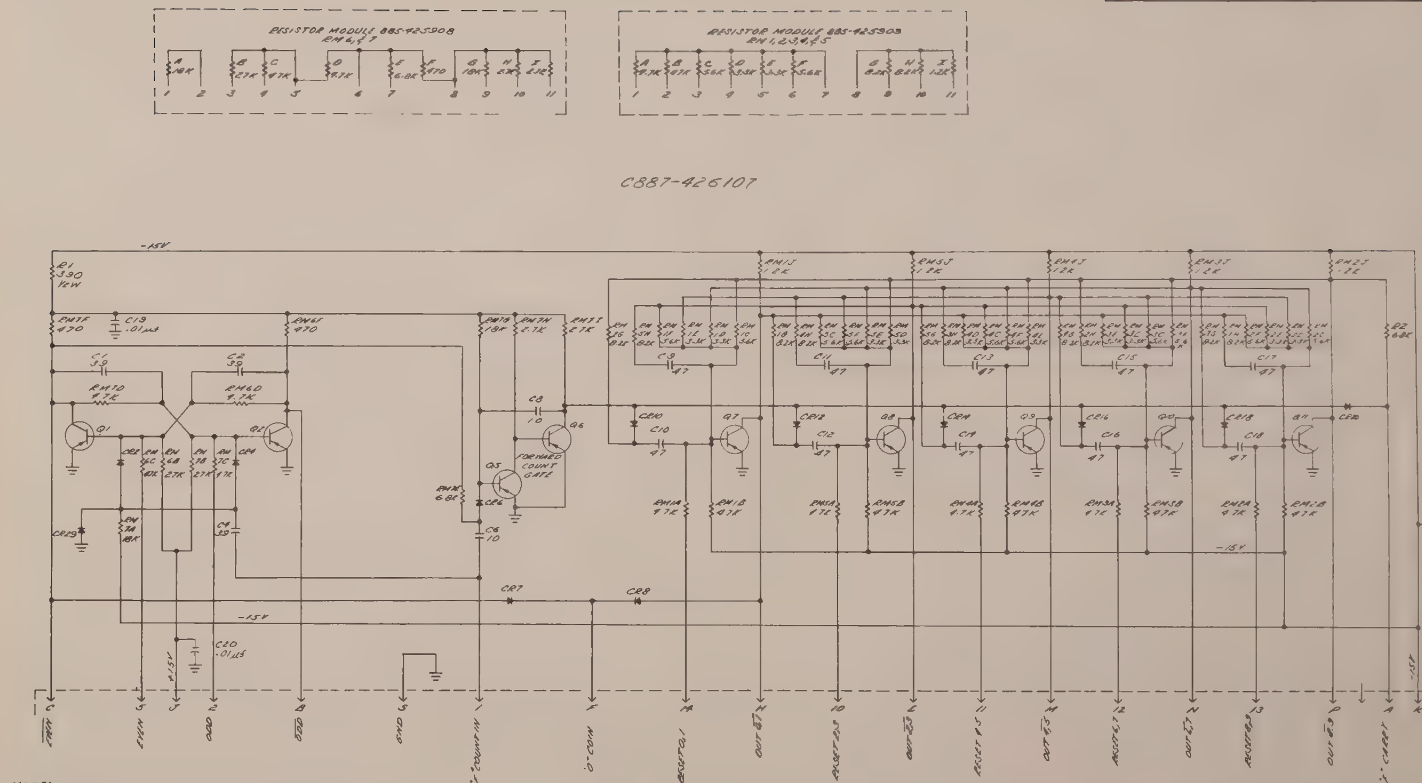
(Model 6020A: A15 thru A19, A22 & A23)
(Model 6030A: A16 thru A20, A38 & A39)

BI-QUINARY DCU
(FORWARD ONLY, WITHOUT READOUT)
(A15, A16, A17, A18, A19, A22, A23*)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A15 thru A19, A22, A23	887-426107C	Bi-Quinary DCU (Fwd. Only) without Readout	Beckman	7
C1, 2, 4	633-839570	Cap., 39pf, 500V, 10%	Skottie TSD4-390K-1/2	3
C6, 8	633-839569	Cap., 10pf, 500V, 10%	Skottie TSD4-100K-1/2	2
C9 thru 18	633-839568	Cap., 47pf, 500V, 10%	Skottie TSD4-470K-1/2	10
C19, 20, 21	633-836864	Cap., 0.01μf, 50V	Sprague 19C214A6	3
CR2, 4, 6, 7, 8, 10, 12, 14, 16, 18, 20, 29	755-431324	Diode, Special	Beckman	12
Q1, 2, 5 thru 11	755-425735	Transistor, Special	Beckman	9
R1	601-015444	Resistor, F.Comp., 390Ω, 1/2W, 5%	Allen Bradley EB3915	1
R2	601-822299	Resistor, F.Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	1
RM1 thru 5	885-425909	Resistor Module	Beckman	5
RM6, 7	885-425908	Resistor Module	Beckman	2

*A15 thru A19, A22, A23: Model 6020A only.
Designations are changed to A16 thru A20, A38 and A39, respectively, for Model 6030A.

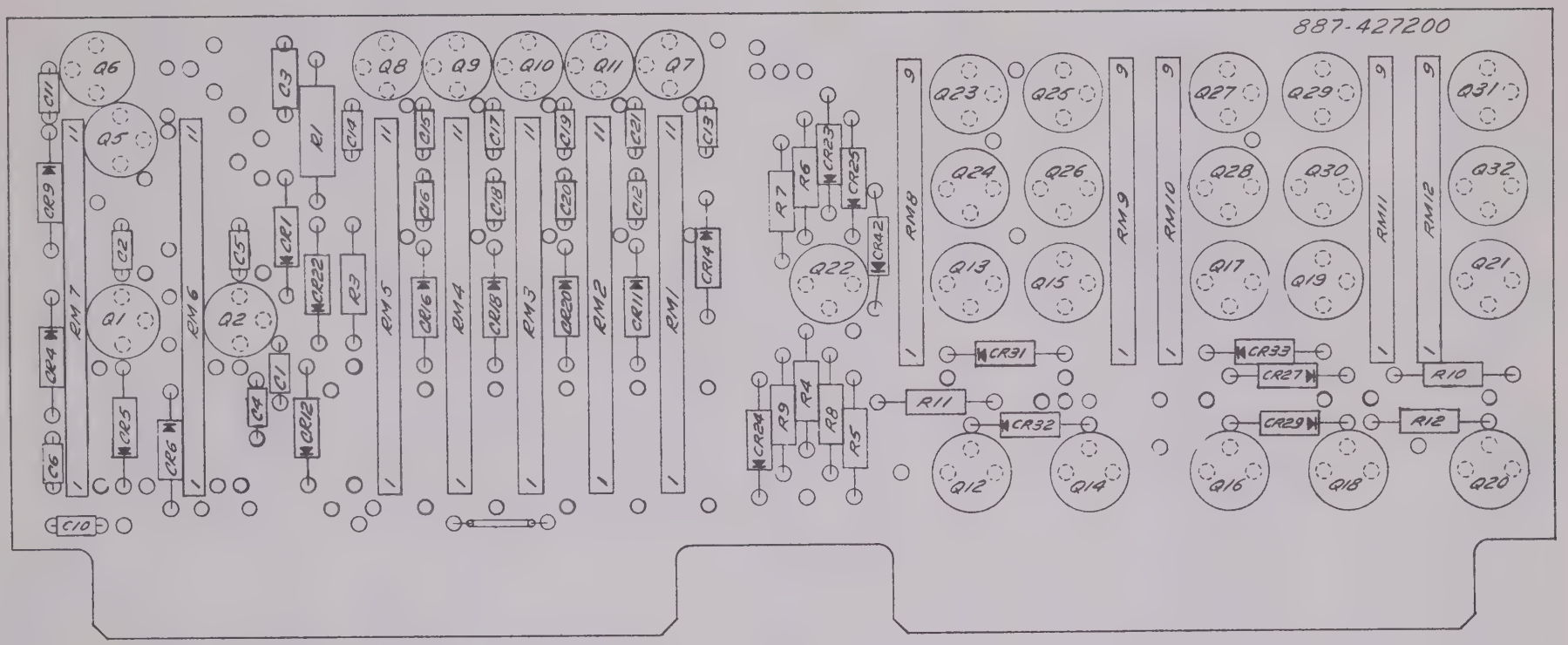
BI-QUINARY DCU
(FWD. ONLY, wo/READOUT)
SCHEMATIC DIAGRAM



NOTE:
1.) RESISTORS: 1/4W, 5%, UNLESS OTHERWISE INDICATED.
2.) DIODES: BECKMAN A755-431924 " " " "
3.) TRANSISTORS: 425735 " " " "
4.) CAPACITORS: IN pf. " " " "
5.) XX = NEG TRUE.
6.) * - DIODES: 420893

COMP OMITTED			
Q	R	C	CR
3, 4	3, 4	3, 5, 7	1, 3 5, 9 11, 13 15, 17 19, 21 THRU 28

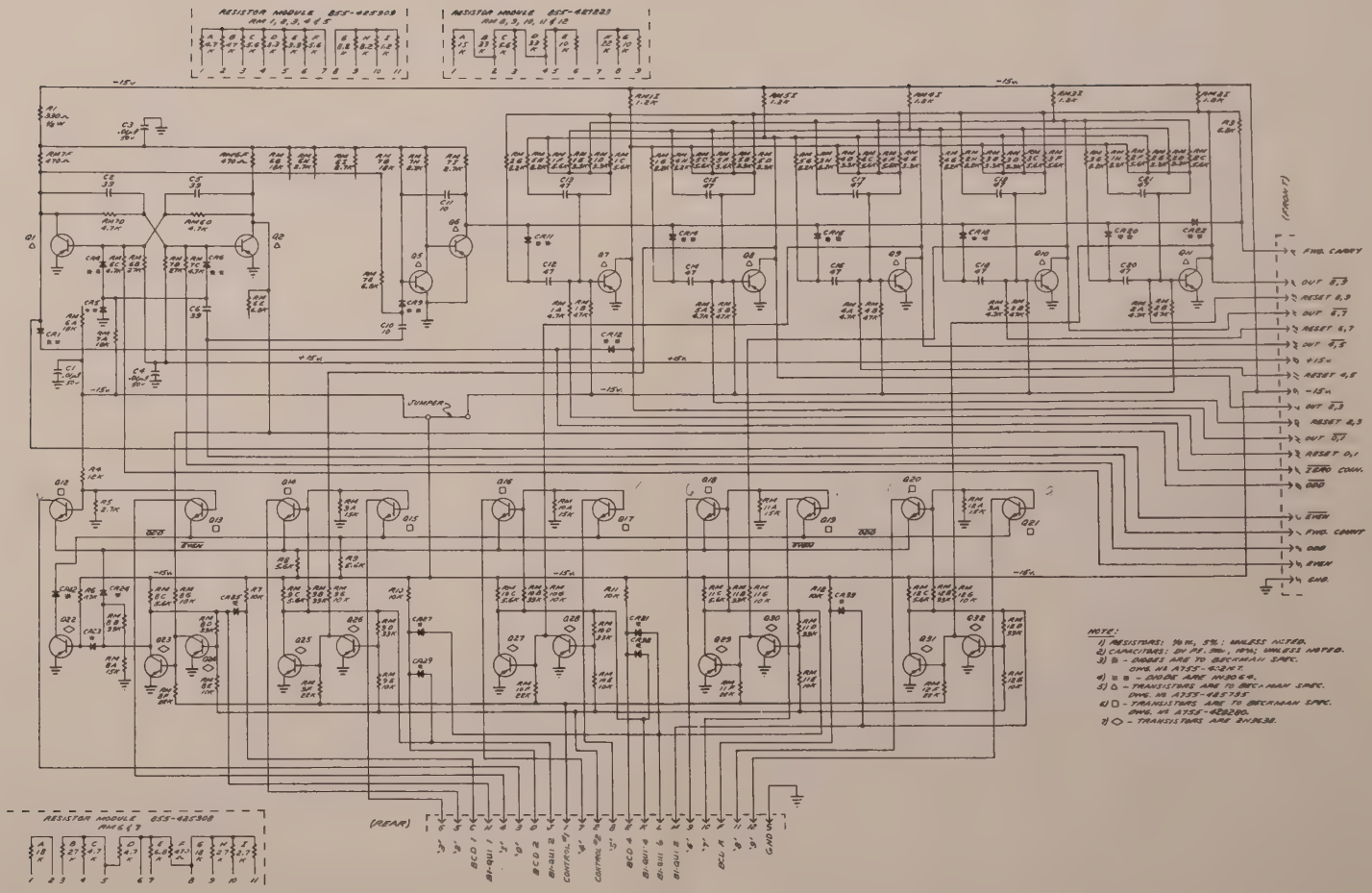
BAYTRON SYSTEMS CORP.
3303 B-7 Harbor Blvd.
Costa Mesa, Calif. 92626
(714) 557-1682

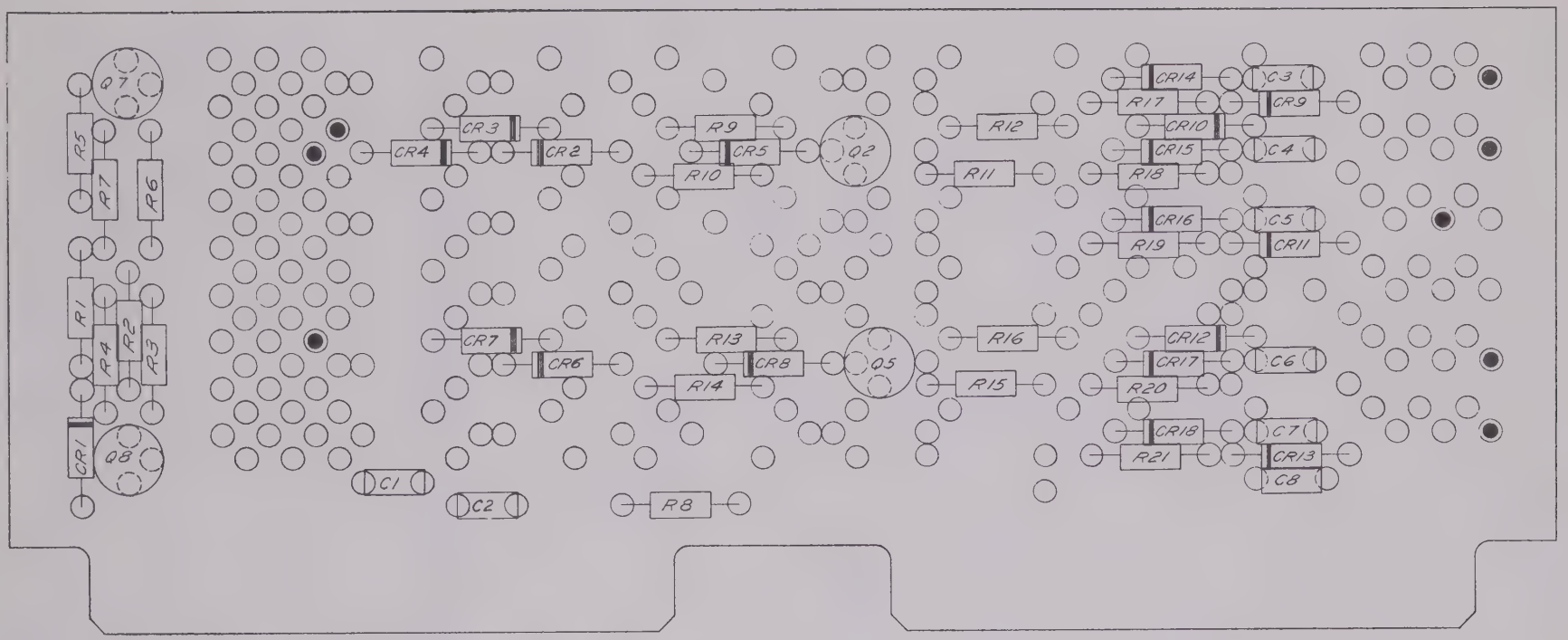


BI-QUINARY DCU (FWD. ONLY, w/LATCHING READOUT) COMPONENT LAYOUT

BI-QUINARY DCU BOARD
(FORWARD ONLY, W/LATCHING READOUT)
(A4 thru A8)

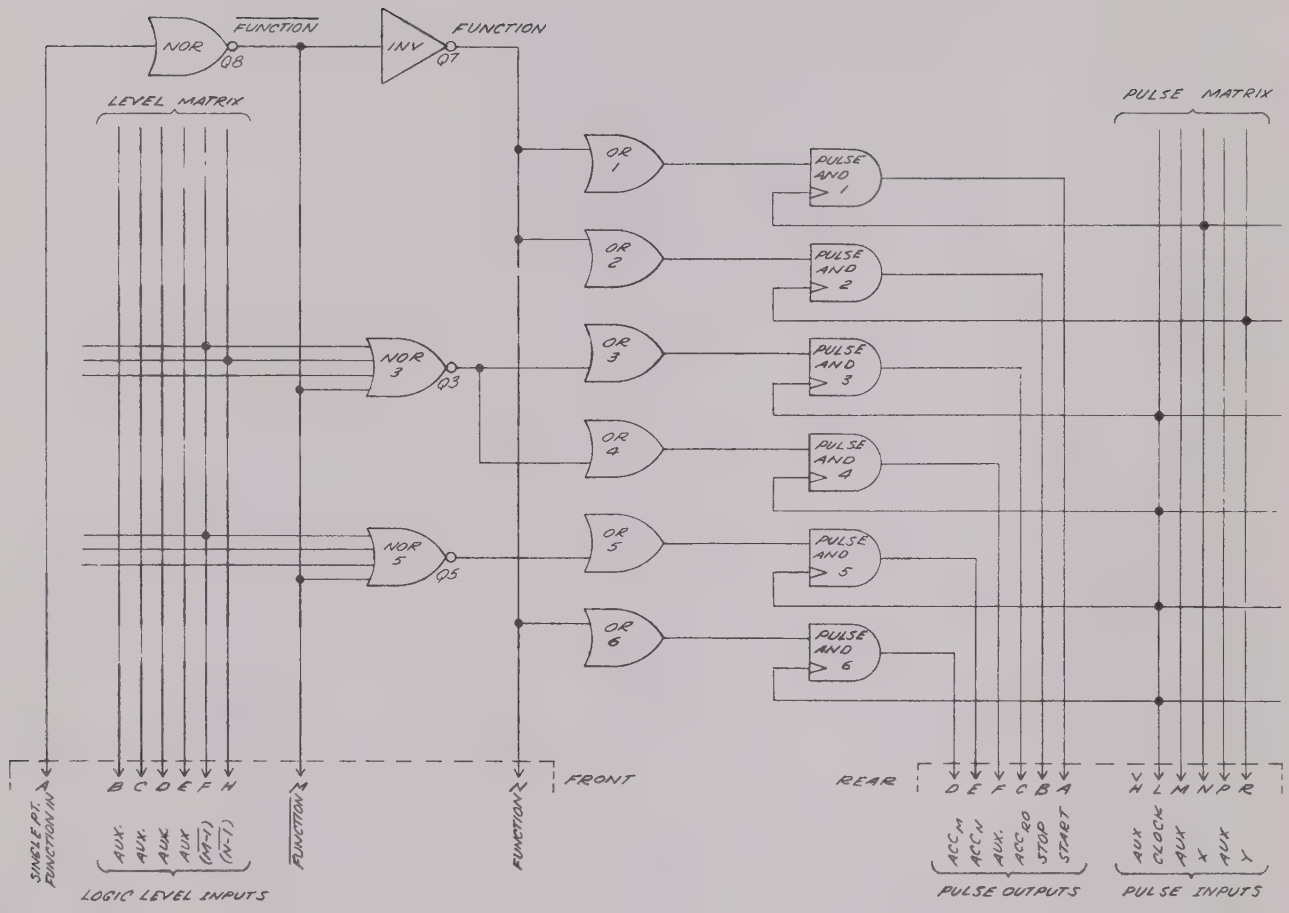
Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A4 thru A8	887-427200C	Bi-Quinary DCU Board, Forward only, w/Latching Readout	Beckman	5
C1, 3, 4	633-804715	Cap., F.Cerm., 0.01μf, 50V	Sprague 19C214	3
C2, 5, 6	633-839570	Cap., F.Cerm., 39pf, 500V, 10%	Skottie TSD4-390K-1/2	3
C10, 11	633-839569	Cap., F.Cerm., 10pf, 500V, 10%	Skottie TSD4-100K-1/2	2
C12 thru 21	633-839568	Cap., F.Cerm., 47pf, 500V, 10%	Skottie TSD4-470K-1/2	10
CR1, 4, 5, 6, 9, 11, 12, 14, 16, 18, 20, 22	755-431324	Diode, Silicon, Special	Beckman	12
CR23, 24, 25, 27, 29, 31, 32, 33, 42	755-402107	Diode, Germanium, Special	Beckman	9
Q1, 2, 5, 6, 7, 8, 9, 10, 11	755-425735	Transistor, Special	Beckman	9
Q12 thru 21	755-428280	Transistor, Special	Beckman	10
Q22 thru 32	755-838105	Transistor	Fairchild 2N3638	11
R1	601-015443	Resistor, F.Comp., 330Ω, 1/2W, 5%	Allen Bradley EB3315	1
R3	601-822299	Resistor, F.Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	1
R4	601-822333	Resistor, F.Comp., 12K, 1/4W, 5%	Allen Bradley CB1235	1
R5	601-822295	Resistor, F.Comp., 2.7K, 1/4W, 5%	Allen Bradley CB2725	1
R6	601-823902	Resistor, F.Comp., 47K, 1/4W, 5%	Allen Bradley CB4735	1
R7, 10, 11, 12	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	4
R8, 9	601-822397	Resistor, F.Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	2
RM1 thru 5	885-425909	Resistor Module	Beckman	5
RM6, 7	885-425908	Resistor Module	Beckman	2
RM8 thru 12	885-427223	Resistor Module	Beckman	5
	864-832780	Transistor Pad	Miltonross 10034	9
	864-412958	Transistor Pad	Beckman	21


RESISTOR MODULE 055-485909
RESISTOR MODULE 055-487823
RESISTOR MODULE 055-485908
-15v.
+15v.
JUMPER
(REAR)
FWD. CARRY
OUT 8,9
RESET 8,9
OUT 6,7
RESET 6,7
OUT 4,5
RESET 4,5
OUT 2,3
RESET 2,3
OUT 0,1
RESET 0,1
ZERO COUN.
FWD. COUNT
GND.
GND OUT
NOTE:
1) RESISTORS: ¼ W, 5%; UNLESS NOTED.
2) CAPACITORS: 5V PF. MIN., 10%; UNLESS NOTED.
3) ⊕ - DIODES ARE TO BECKMAN SPEC. DWG. NO. 473S-482467.
4) ⊠ - DIODE ARE IN3064.
5) △ - TRANSISTORS ARE TO BECKMAN SPEC. DWG. NO. 473S-483735.
6) □ - TRANSISTORS ARE TO BECKMAN SPEC. DWG. NO. 473S-482280.
7) ◇ - TRANSISTORS ARE 2N3638.



TIM FUNCTION BOARD COMPONENT LAYOUT (A13)

(Model 6030A Only)



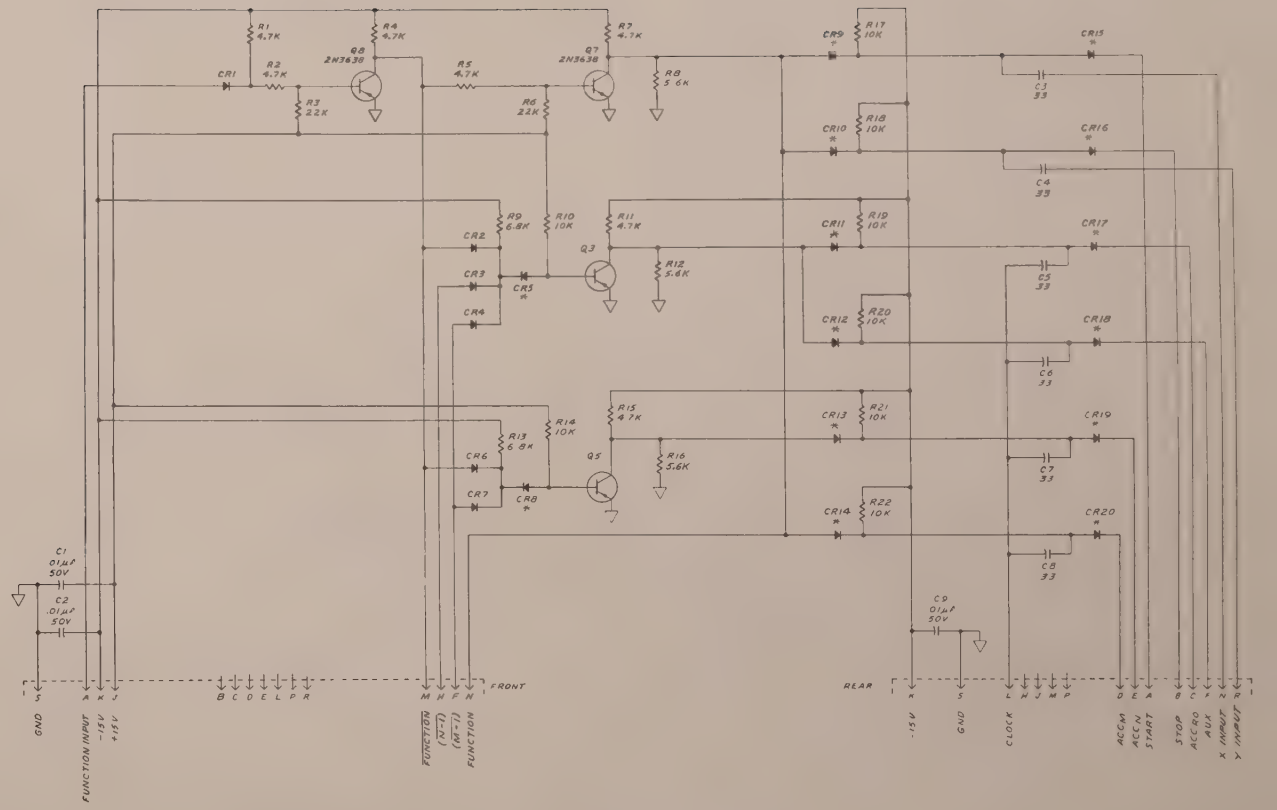
MODEL 6030A TIM FUNCTION LOGIC DIAGRAM

Beckman

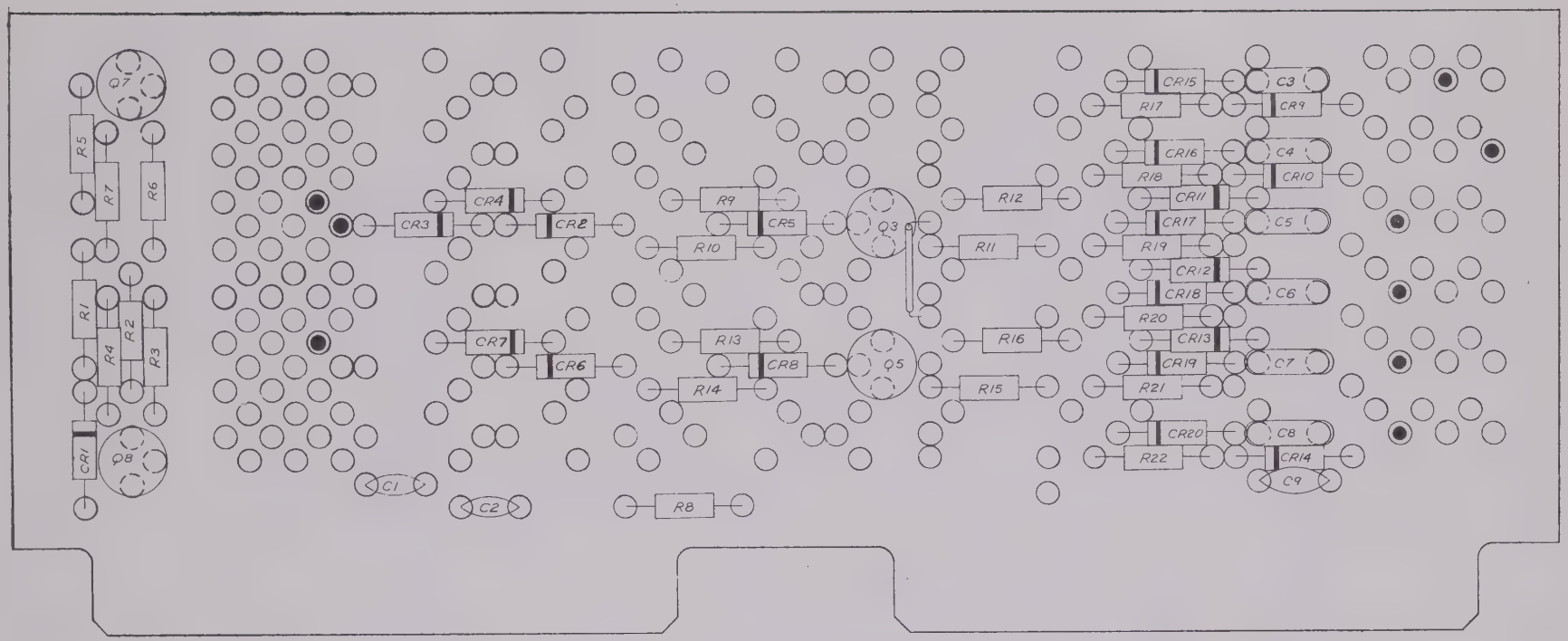
TIM FUNCTION BOARD (A13)
Model 6030A Only

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A13	887-429031 (C)	TIM Function Board	Beckman	1
C1, 2, 9	633-836864	Cap., F.Cerm., 0.01μf, 50V	Sprague 19C214A6	3
C3 thru C8	637-822976	Cap., F. Mica, 33pf, 300V, 5%	Electromotive DM15E330J-300	6
CR1, 2, 3, 4, 6, 7	755-420893	Diode, Special	Beckman	6
CR5, 8 thru 20	755-431324	Diode, Special, CD6111	Beckman	14
Q3, 5	755-425735	Transistor, Special	Beckman	2
Q7, 8	755-838105	Transistor	Fairchild 2N3638	2
R1, 2, 4, 5, 7, 11, 15	601-822297	Resistor, F.Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	7
R3, 6	601-822334	Resistor, F.Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	2
R8, 12, 16	601-823397	Resistor, F.Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	3
R9, 13	601-822299	Resistor, F.Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	2
R10, 14 17 thru 22	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	8
	864-823780	Transistor Pad	Miltonross 10034	4

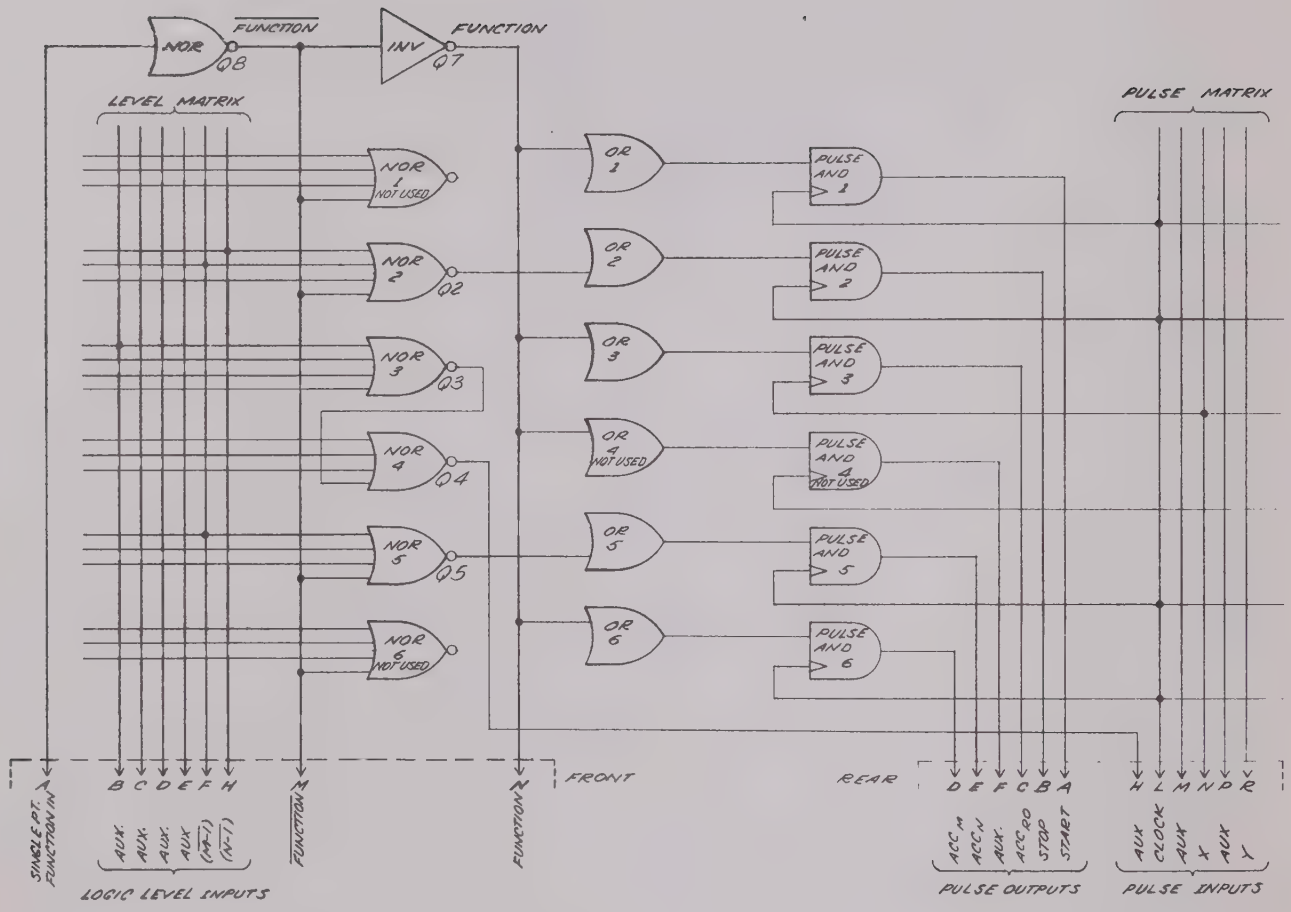
TIM FUNCTION
SCHEMATIC DIAGRAM



NOTES:
1. RESISTORS: 1/4W, 5% UNLESS NOTED.
2. CAPACITORS: IN μF. " NOTED.
3. DIODES: BECKMAN A755-420893 UNLESS NOTED.
4. TRANSISTORS: BECKMAN A755-425735 UNLESS NOTED.
5. DIODES * BECKMAN A755 431324



EPUT FUNCTION BOARD COMPONENT LAYOUT (A10)



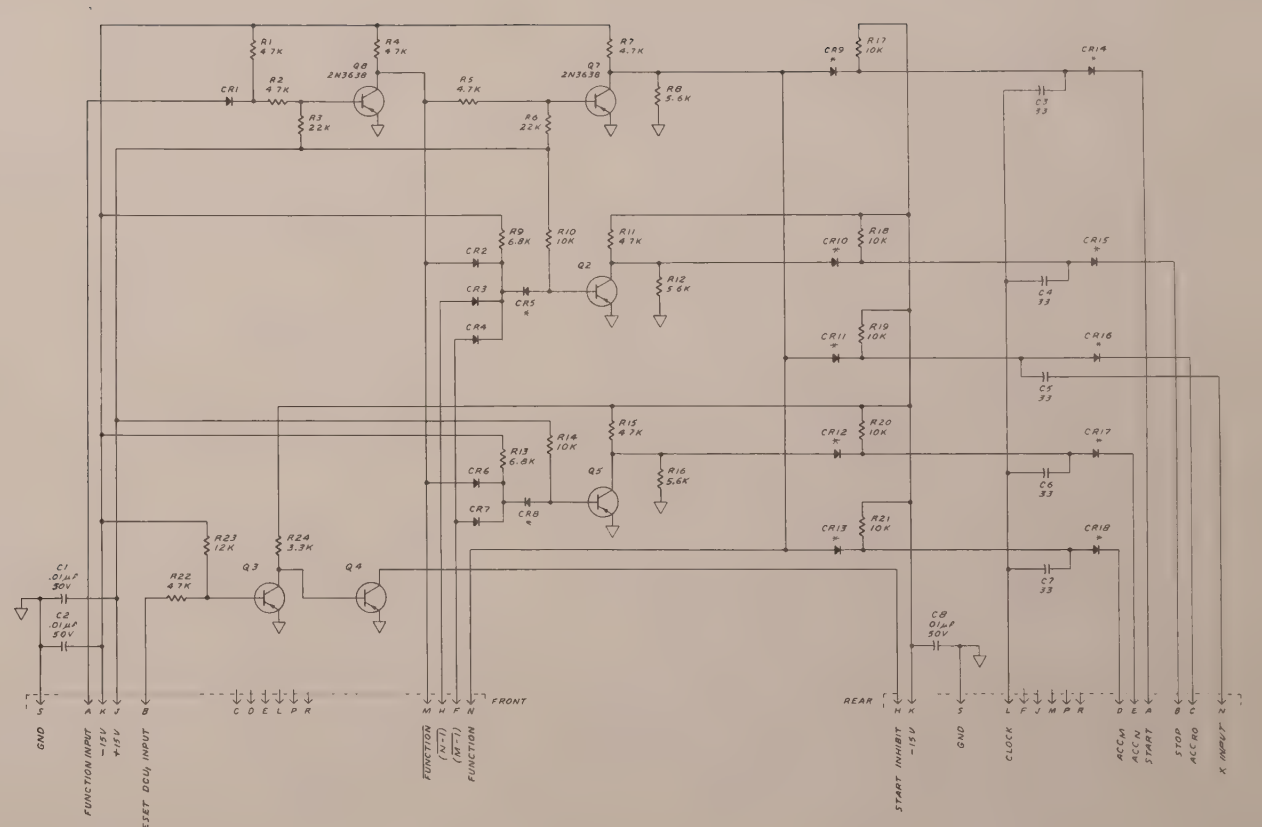
EPUT FUNCTION LOGIC DIAGRAM

Beckman

EPUT© FUNCTION BOARD (A10)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A10	887-425479 (D)	EPUT Function Board	Beckman	1
C1, 2, 8	633-836864	Cap., 0.01μf, 50V	Sprague 19C214A6	3
C3 thru C7	637-822976	Cap., 33pf, 300V, 5%	Electromotive DM15E-330J	5
CR1, 2, 3, 4, 6, 7	755-420893	Diode, Special	Beckman	6
CR5, 8 thru 18	755-431324	Diode, Special	Beckman	12
Q2 thru Q5	755-425735	Transistor, Special	Beckman	4
Q7, 8	755-838105	Transistor, Type 2N3638	Fairchild	2
R1, 2, 4, 5, 7, 11, 15, 22	601-822297	Resistor, F.Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	8
R3, 6	601-822334	Resistor, F.Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	2
R8, 12, 16	601-823397	Resistor, F.Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	3
R9, 13	601-822299	Resistor, F.Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	2
R10, 14, 17 thru 21	601-822324	Resistor, F.Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	7
R23	601-801803	Resistor, F.Comp., 12K, 1/4W, 5%	Allen Bradley CB1235	1
R24	601-822296	Resistor, F.Comp., 3.3K, 1/4W, 5%	Allen Bradley CB3325	1
	864-832780	Transistor Pad	Miltonross 10034	6

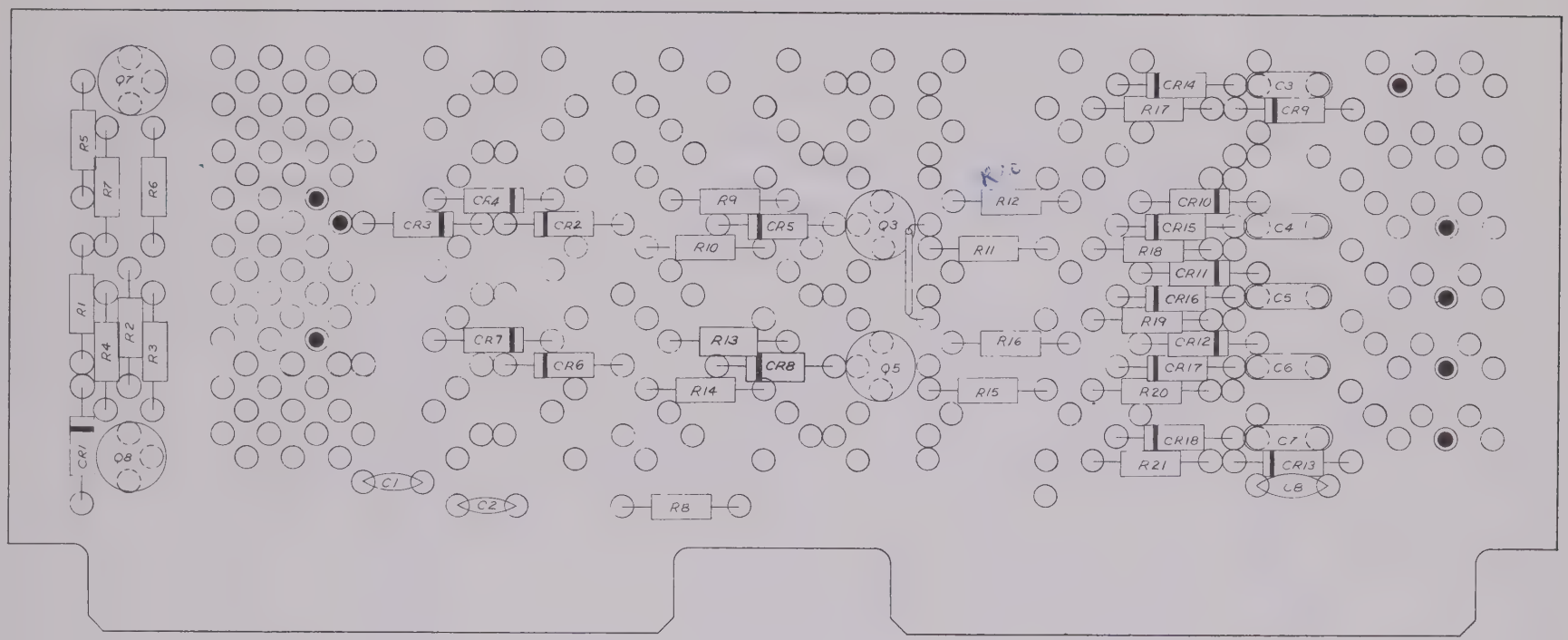
EPUT FUNCTION SCHEMATIC DIAGRAM



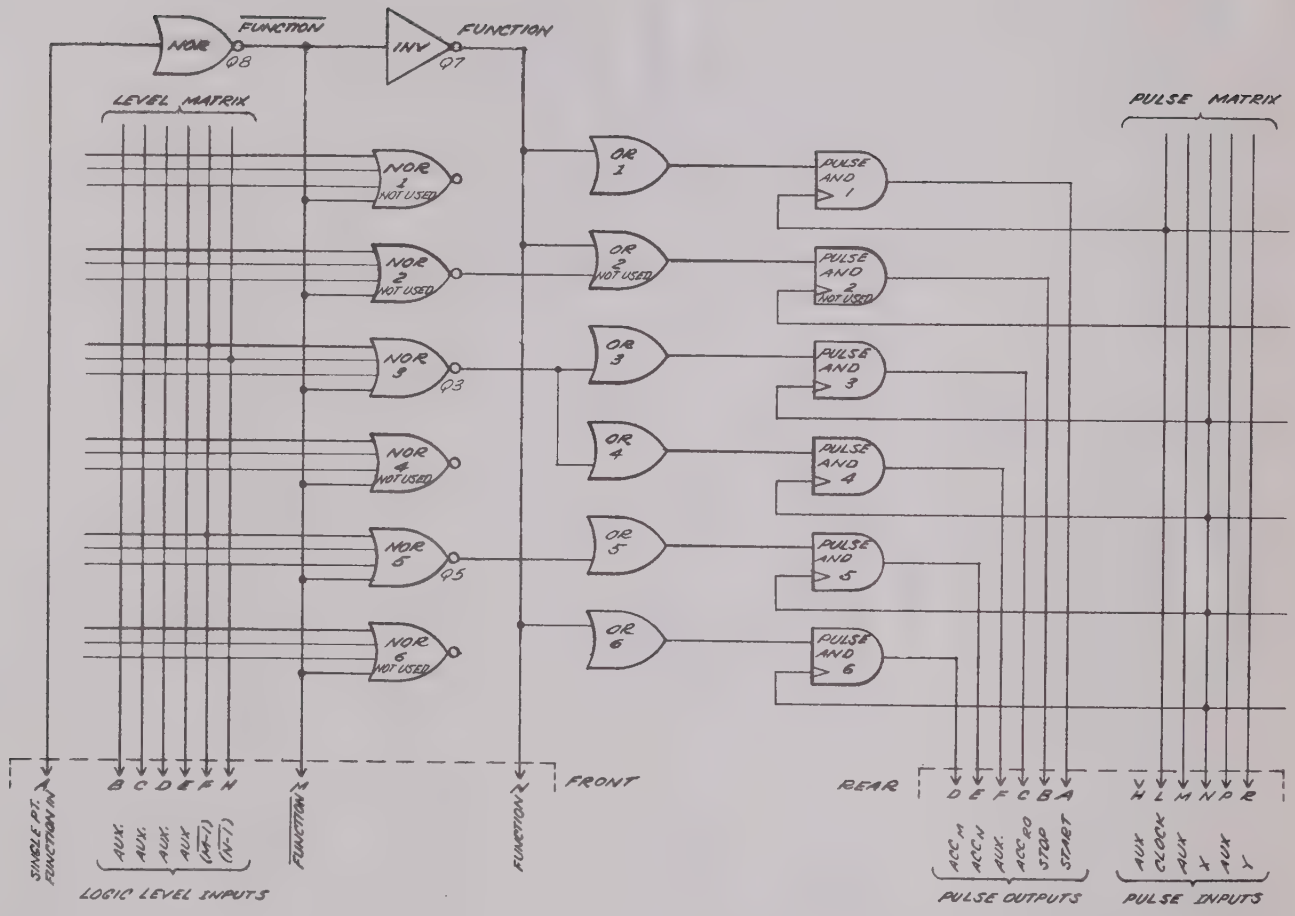
NOTES:
1. RESISTORS: 1/4W, 5% UNLESS NOTED.
2. CAPACITORS: IN P.F. " NOTED.
3. DIODES: BECKMAN A755-420893 UNLESS NOTED.
4. TRANSISTORS: BECKMAN A755-425735 UNLESS NOTED.
5. ▽ BECKMAN A755-431324

6020A & 6030A
D 431141-Rev. D
April 1967

Beckman®



COUNT FUNCTION BOARD COMPONENT LAYOUT (A13)



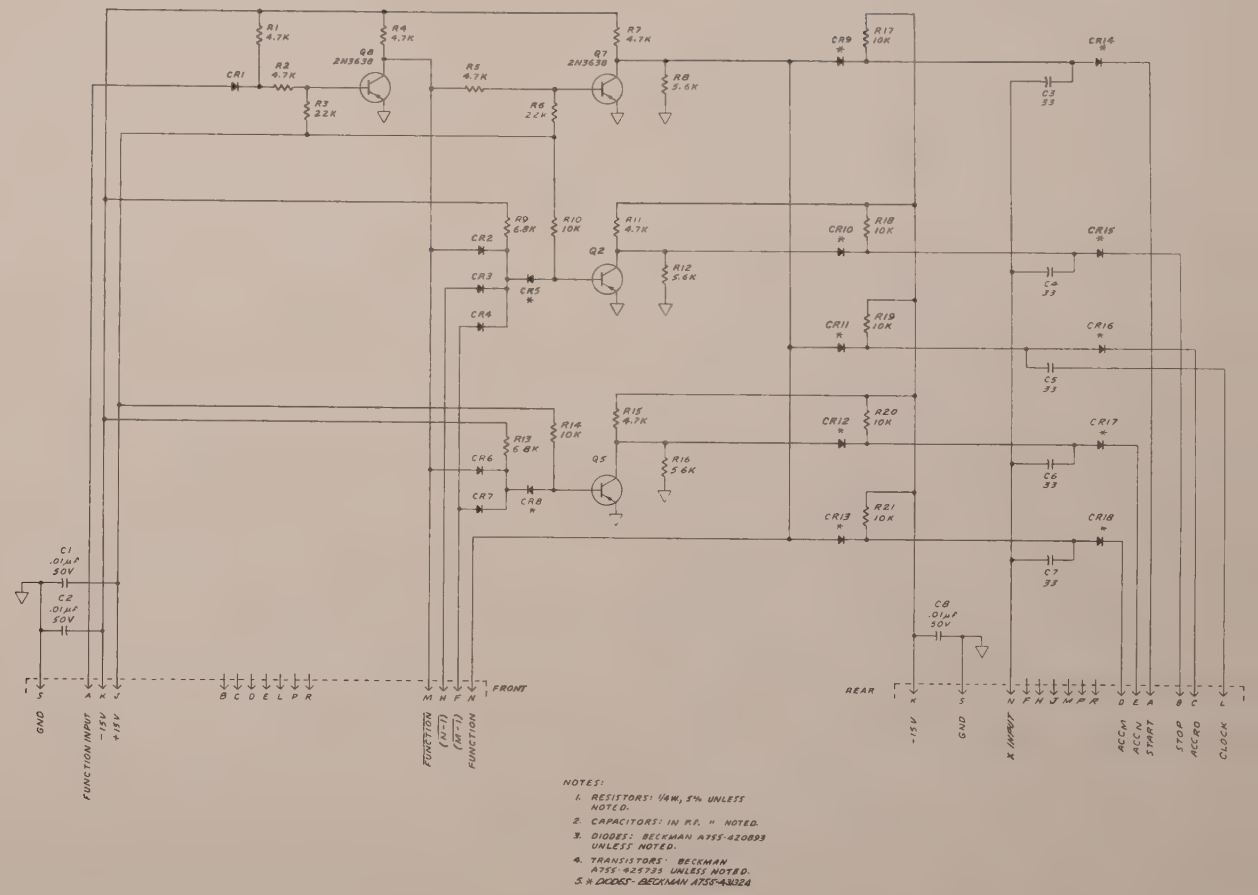
MODEL 6020A COUNT FUNCTION LOGIC DIAGRAM

Beckman

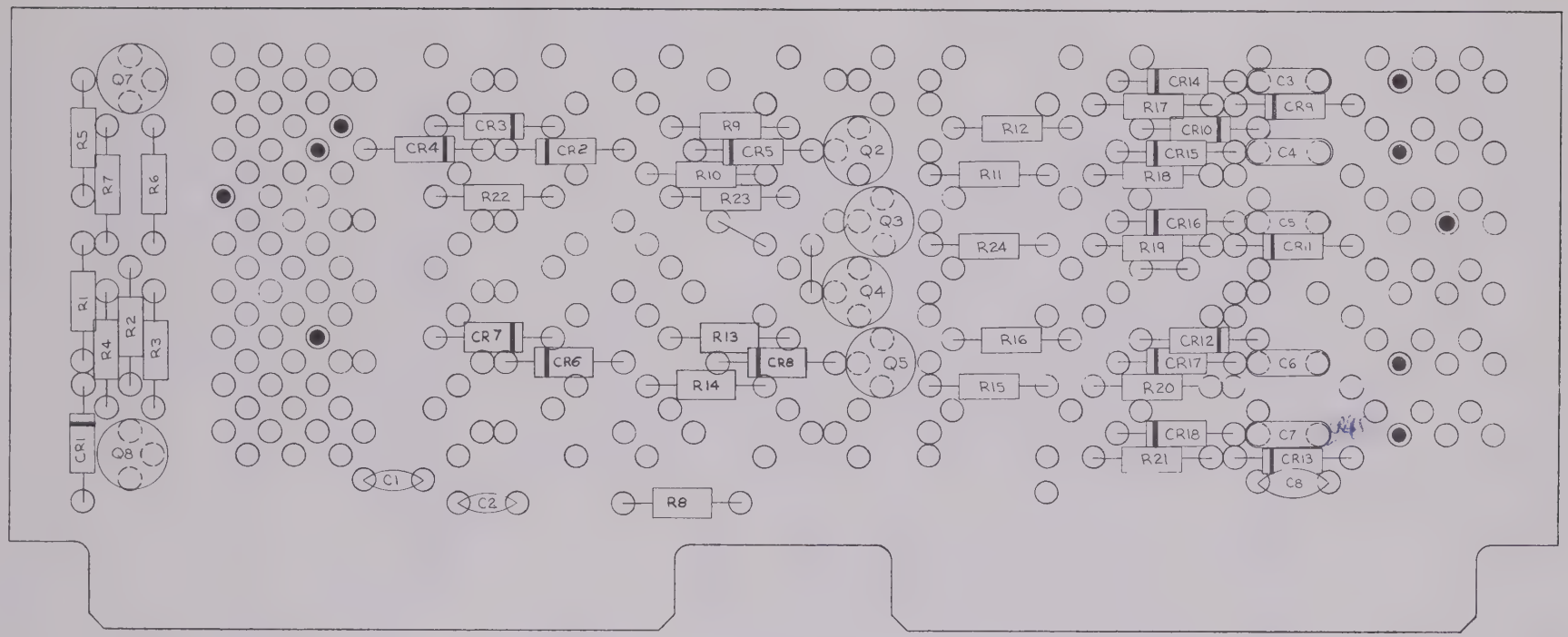
PERIOD FUNCTION BOARD (A11)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A11	887-425481 (D)	Period Function Board	Beckman	1
C1, 2, 8	633-836864	Cap., 0.01μf, 50V	Sprague 19C214 A6	3
C3 thru 7	637-822976	Cap., 33pf, 300V, 5%	Electromotive DM15E-330J	5
CR1, 2, 3, 4, 6, 7	755-420893	Diode, Special	Beckman	6
CR5, 8, 9, 10, thru 18	755-431324	Diode, Special	Beckman	12
Q2, 5	755-425735	Transistor, Special	Beckman	2
Q7, 8	755-838105	Transistor, 2N3638	Fairchild	2
R1, 2, 4, 5, 7, 11, 15	601-822297	Resistor, F. Comp., 4. 7K, 1/4W, 5%	Allen Bradley CB4725	7
R3, 6	601-822334	Resistor, F. Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	2
R8, 12, 16	601-823397	Resistor, F. Comp., 5. 6K, 1/4W, 5%	Allen Bradley CB5625	3
R9, 13	601-822299	Resistor, F. Comp., 6. 8K, 1/4W, 5%	Allen Bradley CB6825	2
R10, 14, 17 thru 21	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	7
	864-832780	Transistor Pad	Miltonross 10034	4

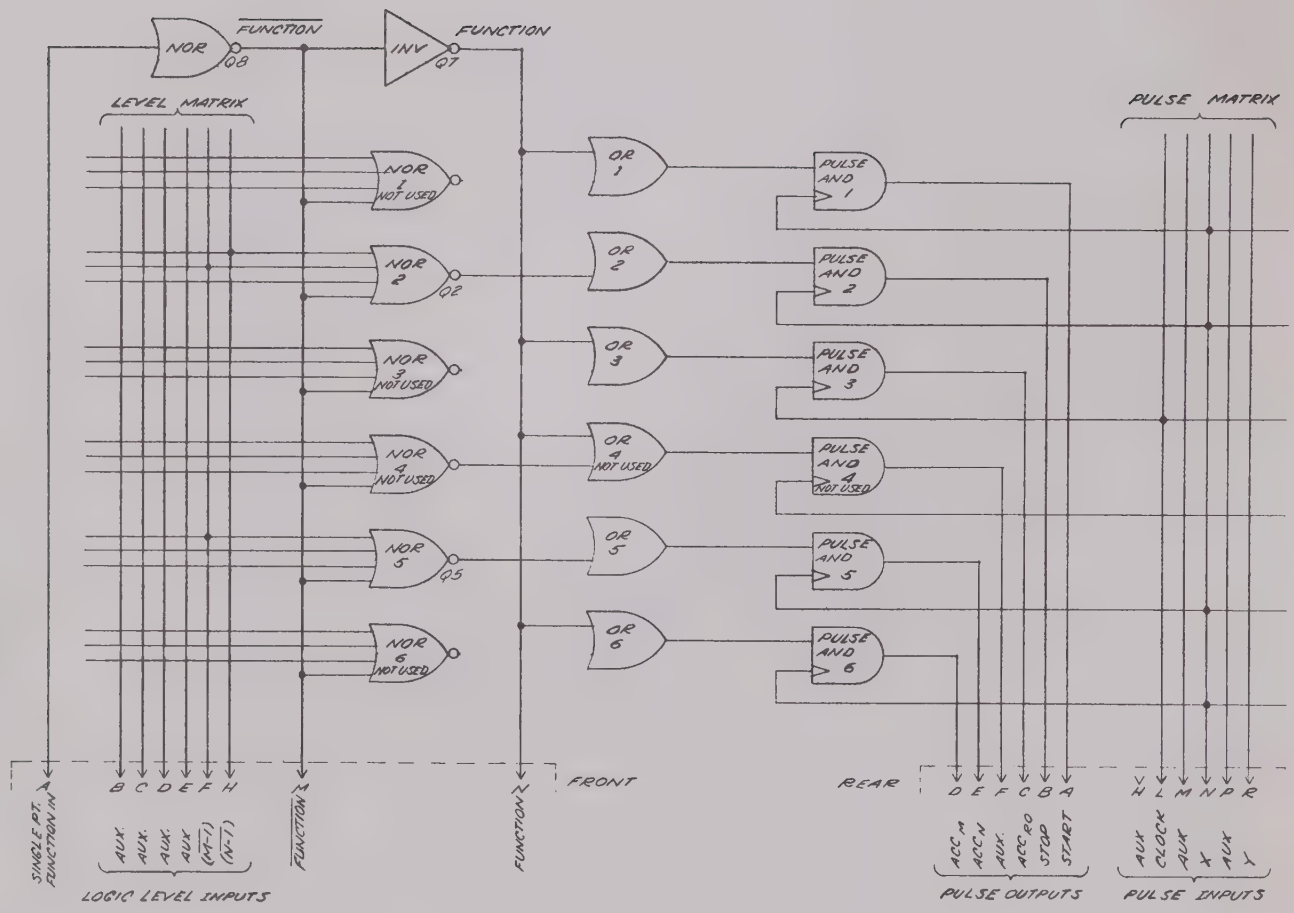
PERIOD FUNCTION SCHEMATIC DIAGRAM



NOTES:
1. RESISTORS: 1/4W, 5% UNLESS NOTED.
2. CAPACITORS: IN M.F. μ NOTED.
3. DIODES: BECKMAN A755-420893 UNLESS NOTED.
4. TRANSISTORS: BECKMAN A755-425735 UNLESS NOTED.
5. * DIODES - BECKMAN A755-431324



PERIOD FUNCTION BOARD COMPONENT LAYOUT (A11)



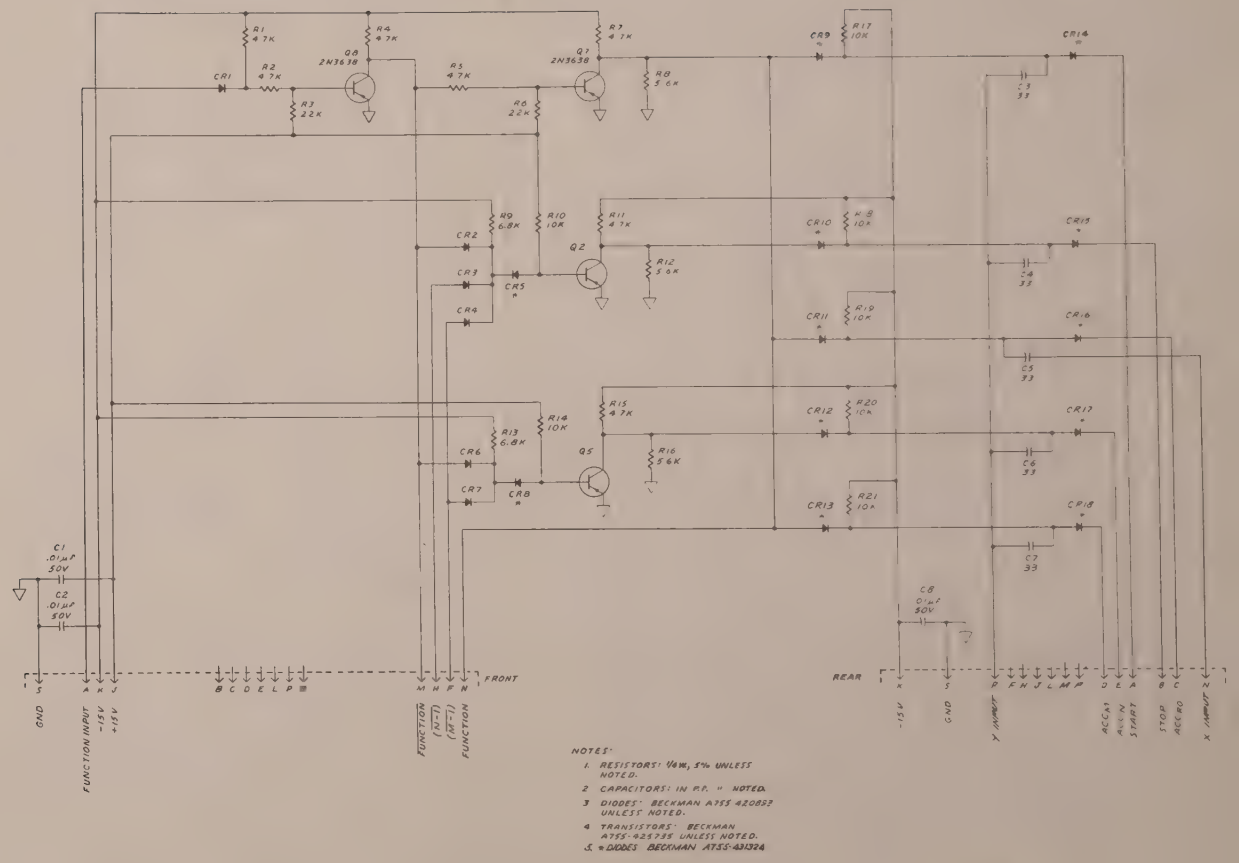
PERIOD FUNCTION LOGIC DIAGRAM

Beckman®

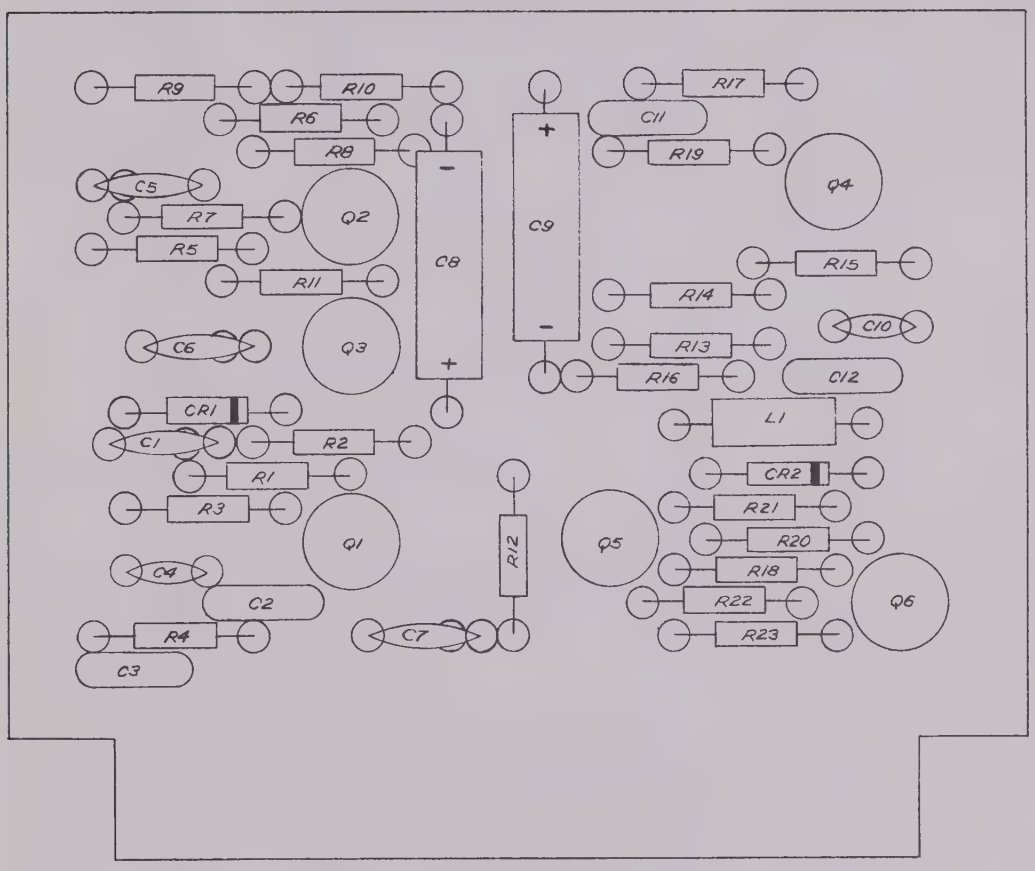
RATIO FUNCTION BOARD (A12)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A12	887-425482 (D)	Ratio Function Board	Beckman	1
C1, 2, 8	633-836864	Cap., 0.01uf, 50V	Sprague 19C214 A6	3
C3 thru 7	637-822976	Cap., 33pf, 300V, 5%	Electromotive DM15E-330J	5
CR1, 2, 3, 4, 6, 7	755-420893	Diode, Special	Beckman	6
CR5, 8, 9, 10, thru 18	755-431324	Diode, Special	Beckman	12
Q2, 5	755-425735	Transistor, Special	Beckman	2
Q7, 8	755-838105	Transistor, 2N3638	Fairchild	2
R1, 2, 4, 5, 7, 11, 15	601-822297	Resistor, F. Comp., 4.7K, 1/4W, 5%	Allen Bradley CB4725	7
R3, 6	601-822334	Resistor, F. Comp., 22K, 1/4W, 5%	Allen Bradley CB2235	2
R8, 12, 16	601-823397	Resistor, F. Comp., 5.6K, 1/4W, 5%	Allen Bradley CB5625	3
R9, 13	601-822299	Resistor, F. Comp., 6.8K, 1/4W, 5%	Allen Bradley CB6825	2
R10, 14, 17 thru 21	601-822324	Resistor, F. Comp., 10K, 1/4W, 5%	Allen Bradley CB1035	7
	864-832780	Transistor Pad	Miltonross 10034	4

RATIO FUNCTION SCHEMATIC DIAGRAM



NOTES:
1. RESISTORS: 1/4W, 5% UNLESS NOTED.
2. CAPACITORS: IN P.F. " NOTED.
3. DIODES: BECKMAN A755 420893 UNLESS NOTED.
4. TRANSISTORS: BECKMAN A755-425735 UNLESS NOTED.
5. * DIODES BECKMAN A755-431324



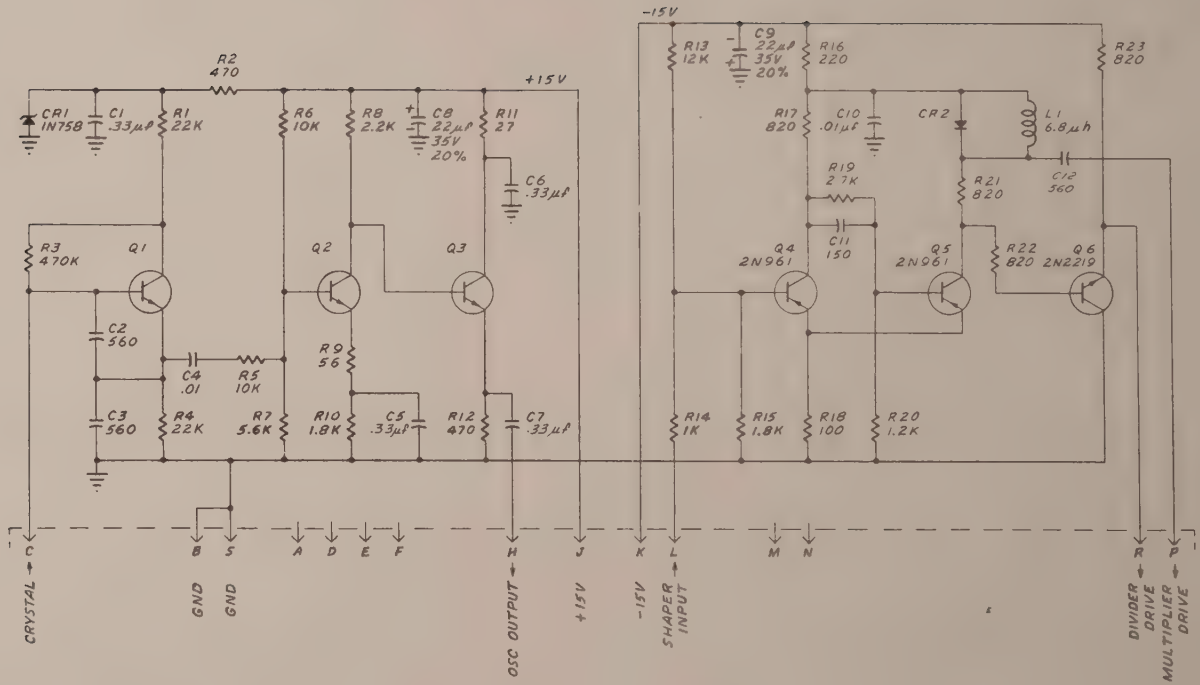
100 KHz OSCILLATOR BOARD COMPONENT LAYOUT

(Model 6020A: A2)
(Model 6030A: A42)

100 KHz OSCILLATOR BOARD (A2, A42*)

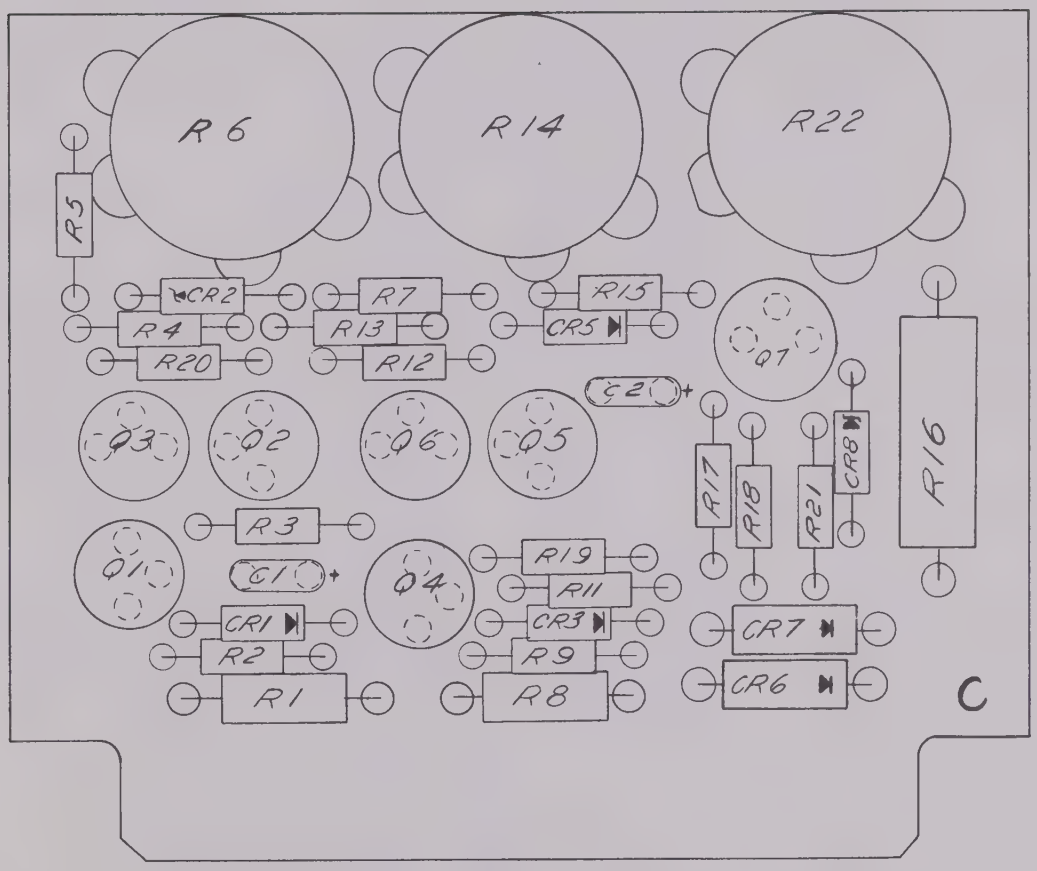
Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Assy.
A2, A42	887-431244 (B)	100 KHz Oscillator Board	Beckman	1
C1, 5, 6, 7	633-815873	Capacitor, F., Ceramic, 0.33μf, 25V	Sprague SC10A	4
C2, 3, 12	637-819381	Capacitor, F., Mica, 560pf, 300V, 5%	Electromotive SCDM15-F561-300	3
C4, 10	633-804715	Capacitor, F., Ceramic, 0.01μf, 50V	Sprague 19C214	2
C8, 9	631-814054	Capacitor, F., Elect., 22μf, 35V, ±20%	Sprague 150D226X-0035R2	2
C11	637-824498	Capacitor, F., Mica, 150μf, 300V, 5%	Electromotive DM15F-151J-300	1
CR1	755-809734	Diode, Zener, Type 1N758	Cont. Device	1
CR2	755-402107	Diode, Special	Beckman	1
L1	795-827337	Inductor, 6.8μh, 10%	Nat'l NB-6.81	1
Q1, 2, 3	755-419596	Transistor, Special	Beckman	3
Q4, 5	755-817811	Transistor, Germanium, Type 2N961	Motorola	2
Q6	755-823113	Transistor, Silicon, Type 2N2219	Motorola	1
R1, 4	601-822334	Resistor, F., Comp., 22k, 1/4 W, 5%	Allen Bradley CB2235	2
R2, 12	601-823395	Resistor, F., Comp., 470Ω, 1/4W, 5%	Allen Bradley CB4715	2
R3	601-823912	Resistor, F., Comp., 470k, 1/4W, 5%	Allen Bradley CB4745	1
R5, 6	601-822324	Resistor, F., Comp., 10k, 1/4W, 5%	Allen Bradley CB1035	2
R7	601-823397	Resistor, F., Comp., 5.6k 1/4W, 5%	Allen Bradley CB5625	1
R8	601-822328	Resistor, F., Comp., 2.2k 1/4W, 5%	Allen Bradley CB2225	1
R9	601-823388	Resistor, F., Comp., 56Ω, 1/4W, 5%	Allen Bradley CB5605	1
R10, 15	601-822544	Resistor, F., Comp., 1.8k, 1/4W, 5%	Allen Bradley CB1825	2
R11	601-823384	Resistor, F., Comp., 27Ω, 1/4W, 5%	Allen Bradley CB2705	1
R13	601-801803	Resistor, F., Comp., 12k, 1/4W, 5%	Allen Bradley CB1235	1
R14	601-822308	Resistor, F., Comp., 1k, 1/4W, 5%	Allen Bradley CB1025	1
R16	601-822327	Resistor, F., Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	1
R17, 21, 22, 23	601-822306	Resistor, F., Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	4
R18	601-817735	Resistor, F., Comp., 100Ω, 1/4W, 5%	Allen Bradley CB1015	1
R19	601-822295	Resistor, F., Comp., 2.7k, 1/4W, 5%	Allen Bradley CB2725	1
R20	601-822326	Resistor, F., Comp., 1.2k, 1/4W, 5%	Allen Bradley CB1225	1

* A2: Model 6020A
  A42: Model 6030A



NOTE:

1. RESISTORS ARE 1/4W., 5% EXCEPT AS NOTED.
2. CAPACITOR VALUES IN Pf EXCEPT AS NOTED.
3. DIODES ARE PER BECKMAN SPEC A755-402107 EXCEPT AS NOTED.
4. TRANSISTORS ARE PER BECKMAN SPEC A755-419596 EXCEPT AS NOTED.



REGULATOR BOARD COMPONENT LAYOUT (A1)

BAYTRON SYSTEMS CORP.
3303 B-7 Harbor Blvd.
Costa Mesa, Calif. 92626
(714) 557-1682

REGULATOR BOARD (A1)

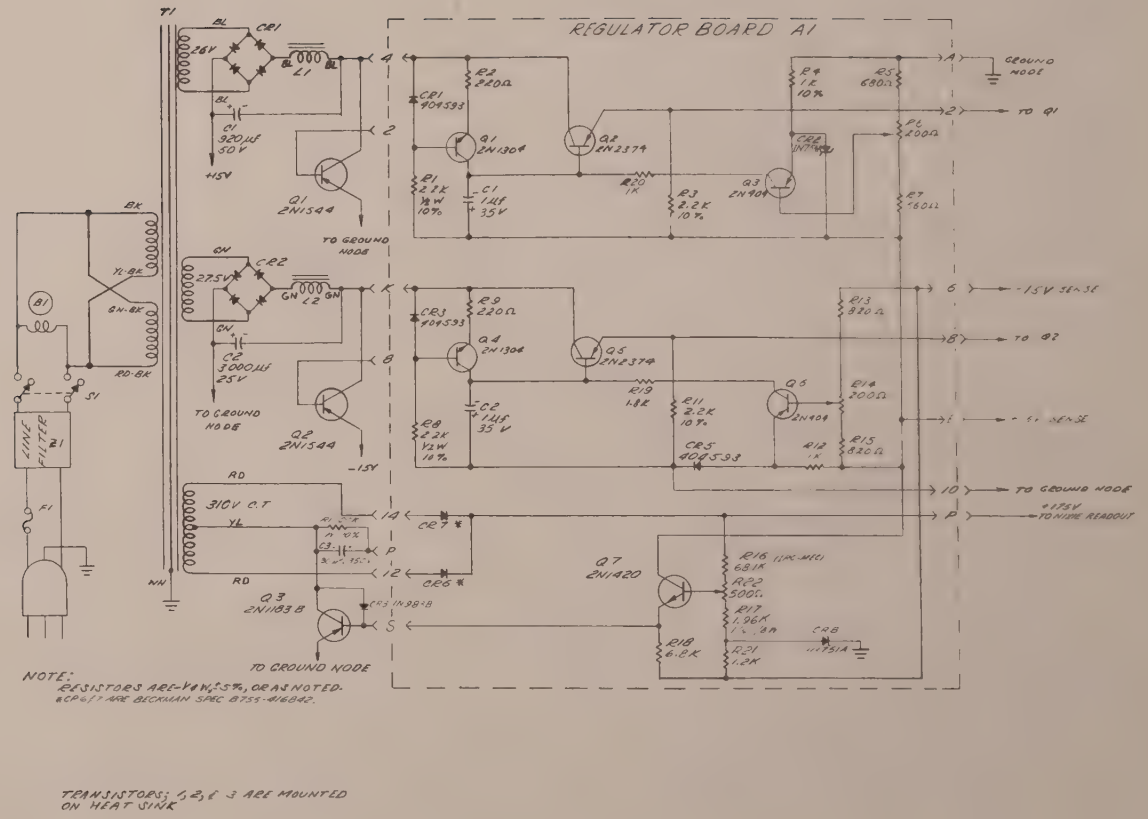
(Models 6020A and 6030A)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
A1	887-426753 E	Regulator Board	Beckman	1
C1, 2	631-844520	Capacitor, Elect., 1μf, 35V, ±20%	Kemet K1P35	2
CR1, 3, 5	755-404593	Diode, Special	Beckman	3
CR2	755-814019	Diode, Zener, 1N754A	Motorola	1
CR6, 7	755-416842	Diode, Special	Beckman	2
CR8	755-814045	Diode, 1N751A	Motorola	1
Q1, 4	755-817210	Transistor, Silicon, 2N1034	Texas Instruments	2
Q2, 5	755-836485	Transistor, Germanium, 2N2374	Texas Instruments	2
Q3, 6	755-800398	Transistor, Germanium, 2N404	Sylvania	2
Q7	755-817964	Transistor, Silicon, 2N1420	P.S.I.	1
R1, 8	601-008080	Resistor, F.Comp., 2.2K, 1/2W, 10%	Allen Bradley EB2221	2
R2, 9	601-822327	Resistor, F.Comp., 220Ω, 1/4W, 5%	Allen Bradley CB2215	2
R3, 11	601-812856	Resistor, F.Comp., 2.2K, 1/4W, 10%	Allen Bradley CB2221	2
R4	601-823111	Resistor, F.Comp., 1K, 1/4W, 10%	Allen Bradley CB1021	1
R5	601-822369	Resistor, F. Comp., 680Ω, 1/4W, 5%	Allen Bradley CB6815	1
R6, 14	611-812861	Resistor, Var., W.W., 200Ω	C.T.S. Series 111	2
R7	601-823396	Resistor, F.Comp., 560Ω, 1/4W, 5%	Allen Bradley CB5615	1
R12, 20	601-822308	Resistor, F.Comp., 1K, 1/4W, 5%	Allen Bradley CB1025	2
R13, 15	601-822306	Resistor, F.Comp., 820Ω, 1/4W, 5%	Allen Bradley CB8215	2
R16	607-844498	Resistor, F. Film, 68K, 1%	IRC MEC-TO	1
R17	607-821212	Resistor, F. Film, 1.96K, 1/8W, 1%	IRC CEA-TO	1
R18	601-822299	Resistor, F. Comp. 6.8K, 1/4W, 5%	Allen Bradley CB6825	1
R19	601-822544	Resistor, F. Comp. 1.8K, 1/4W, 5%	Allen Bradley CB1825	1
R21	601-822326	Resistor, F. Comp. 1.2K, 1/4W, 5%	Allen Bradley CB1225	1
R22	611-815619	Resistor, Var. W.W., 500Ω, 1.5W, 20%	C.T.S. Series 111	1
	864-412958	Transistor Pad	Beckman	7

MISCELLANEOUS PARTS -- POWER SUPPLY
(Models 6020A & 6030A)

Detail No.	Beckman Part No.	Description	Typical Manufacturer & No.	Qty./ Ass'y
B1	842-834439	Fan Motor, 0.003HP, CW Rotation	Howard Ind. 1075-3038	1
C1	631-423957	Capacitor, 920 μf, 50V	Beckman	1
C2	631-423959	Capacitor, 1800 μf, 50V	Beckman	1
C3	631-434479	Capacitor, Special	Beckman	1
CR1	774-824972	Rectifier, Bridge, 1.5 Amps	Semtech SCBR2	1
CR2	774-824971	Rectifier, Bridge, 3 Amps	Semtech SA780	1
CR3	755-839087	Diode, 1N983B	Motorola	1
E1	691-839908	Terminal Strip	Kulka 599-12	1
L1	795-423953	Choke	Beckman	1
L2	795-423954	Choke	Beckman	1
Q1, 2	755-822107	Transistor, 2N1544	Motorola	2
Q3	755-829413	Transistor, 2N1183B	Motorola	1
R1	601-042992	Resistor, F.Comp., 100K, 1W, 10%	Allen Bradley GB1041	1
T1	792-426720	Transformer	Beckman	1
XA1	680-824115	Connector, P.C., 30 Contacts	Cinch 251-15-30-160	1
XY1	860-802331	Socket, Tube, 8-Pin, Saddle Mtg. Octal	Cinch 101-22-00-028	1
Z1	771-423828	Filter	Beckman	1
	864-806361	Insulator, Transistor Mtg., Alum.	Monadnock 294457	2
	241-824108	Blower, Nylon, 2-1/2 in.	Howard Ind. 6218-089	1

POWER SUPPLY
SCHEMATIC DIAGRAM



LOGIC SYMBOLS AND TYPICAL CIRCUITS

This section describes logic symbols as used in this manual. Typical circuit configurations are shown with each symbol. Actual circuits used in this instrument may be modifications of these typical circuits.

A. 1 AND GATE

The AND gate is a multiple-input circuit which requires that all inputs be present in order to produce an output.

A typical AND gate is shown in figure A-1.

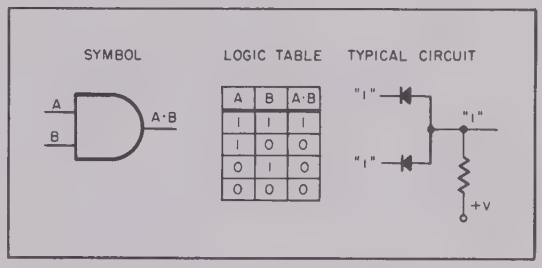


Fig. A-1. AND Gate

A. 2 OR GATE

The OR gate requires the presence of one or more inputs in order to produce an output.

A typical OR gate is shown in figure A-2.

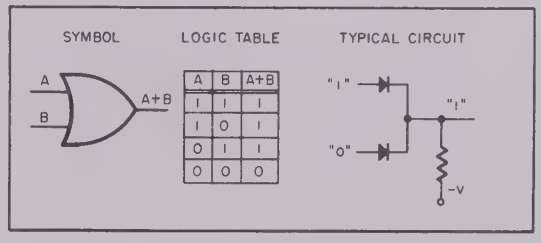


Fig. A-2. Typical OR Gate

A. 3 NAND GATE

The NAND gate is a multiple-input circuit which requires all inputs to be logic 1 in order to produce a logic 0 output.

A typical NAND gate is shown in figure A-3.

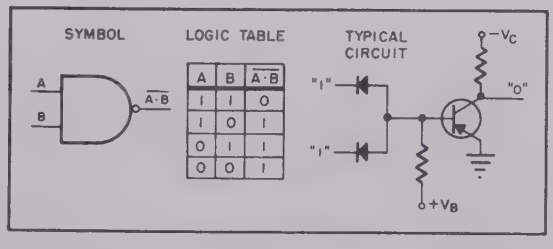


Fig. A-3. Typical NAND Gate

A. 4 NOR GATE

The NOR gate is a multiple-input circuit which requires all inputs to the gate to be logic 0 to produce a logic 1 output.

A typical NOR gate is shown in figure A-4.

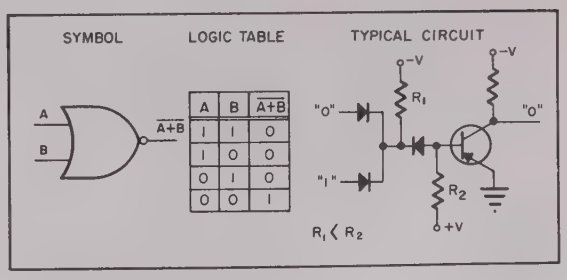


Fig. A-4. Typical NOR Gate

A. 5 POSITIVE AND NEGATIVE ZONE LOGIC

Unless stated otherwise, all logic symbols used in this publication refer to positive true logic. Positive and negative zone logic are defined as follows.

1) Positive Zone Logic:

Positive zone logic exists when all pulses and/or levels occur on the positive side of the zero line.

When logic 1 is more positive than logic 0, it is called "positive zone, positive true". When logic 1 is less positive than logic 0, it is called "positive zone, negative true".

2) Negative Zone Logic:

Negative zone logic exists when all pulses and/or levels occur on the negative side of the zero line.

When logic 1 is less negative than logic 0, it is called "negative zone, positive true". When logic 1 is more negative than logic 0, it is called "negative zone, negative true".

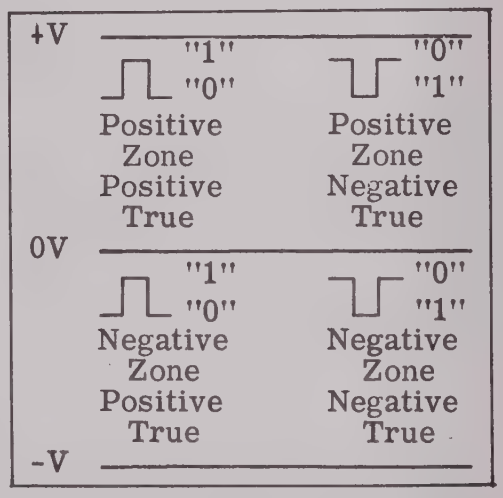


Fig. A-5. Positive and Negative Zone Logic

A.6 INVERTERS AND EMITTER FOLLOWERS

Logic inverting circuits provide a method of converting a logic 0 to a logic 1 or vice versa. Figure A-6 shows the inversion operation and a typical inverting circuit.

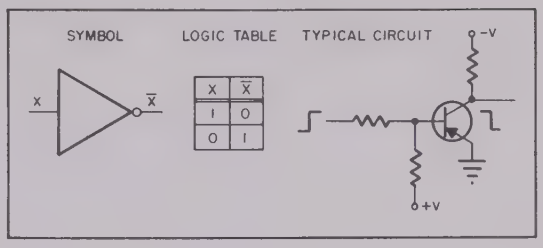


Fig. A-6. Typical Inverter

An emitter follower circuit is represented by the symbol (see figure A-6A). The circuit is so named because the output at the emitter follows the input in phase. This circuit may be used as a current amplifier or as a coupling or impedance matching element.

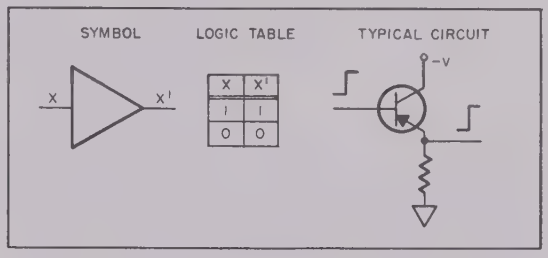


Fig. A-6A. Typical Emitter Follower

A.7 INVERTED TRUE INPUTS

When one input to a logic circuit requires a negative true signal where a positive true signal is usually required, a "not" (o) indication is shown at the particular input terminal of the logic symbol.

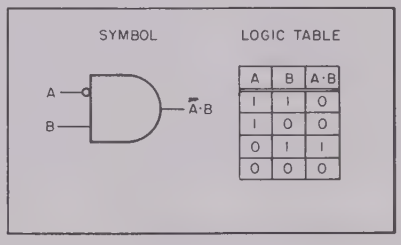


Fig. A-7. AND Gate Using Inverter Control Voltage Level

A.8 FLIP-FLOPS

The bistable multivibrator, or flip-flop, is characterized by having two states, logic 1 or logic 0. Since both states are stable, the binary is commonly used in memory circuits, counting circuits, and shift registers.

A typical flip-flop is shown in figure A-8. In the usual configuration, there are two input lines (logic 1 and logic 0) and two outputs (logic 1 and logic 0).

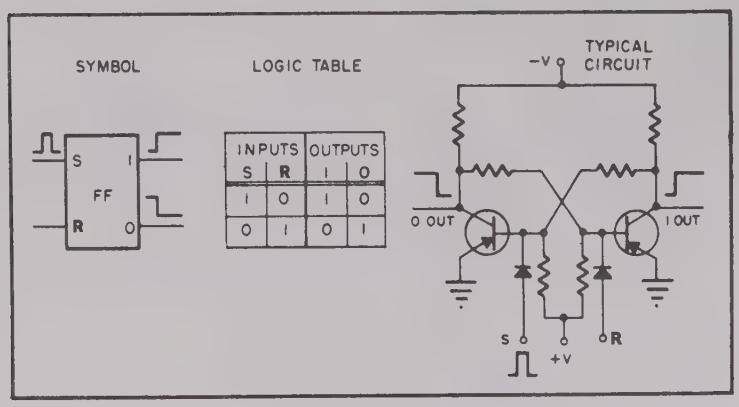


Fig. A-8. Typical Flip-Flop

A signal applied to the set input results in a logic 1 signal at the logic 1 output and a logic 0 signal at the logic 0 output. Conversely, a signal applied to the reset input results in a logic 0 at the logic 1 output and a logic 1 at the logic 0 output.

Positive Pulse Steering

Shown in figure A-8A is a flip-flop using PNP transistors and positive pulse steering. The circuit can exist in either of two stable states: Q1 on, Q2 off; or Q1 off, Q2 on.

Positive input pulses trigger the binary from one stable state to the other through one of the pulse-steering diodes (CR1 or CR2).

Circuit Description

With Q1 conducting and Q2 cut off, a positive input pulse passes through CR1 to the base of Q1. This turns Q1 off. As Q1 turns off, load current decreases and the collector potential approaches -15 volts. This negative transient is coupled through capacitor C1 to the base of Q2, turning Q2 on. Current through Q2 increases and its collector potential rises toward ground. Under these conditions, divider network R6-R4 maintains a positive potential at the base of Q1 to keep it cut off.

The flip-flop remains in this stable state (Q1 off, Q2 on) until the next positive input arrives. At this time, Q2 cuts off, Q1 conducts, and the binary resumes its original state.

---------- NOTE ----------

Logic 1 and logic 0 inputs may also be referred to as set and clear or set and reset inputs.

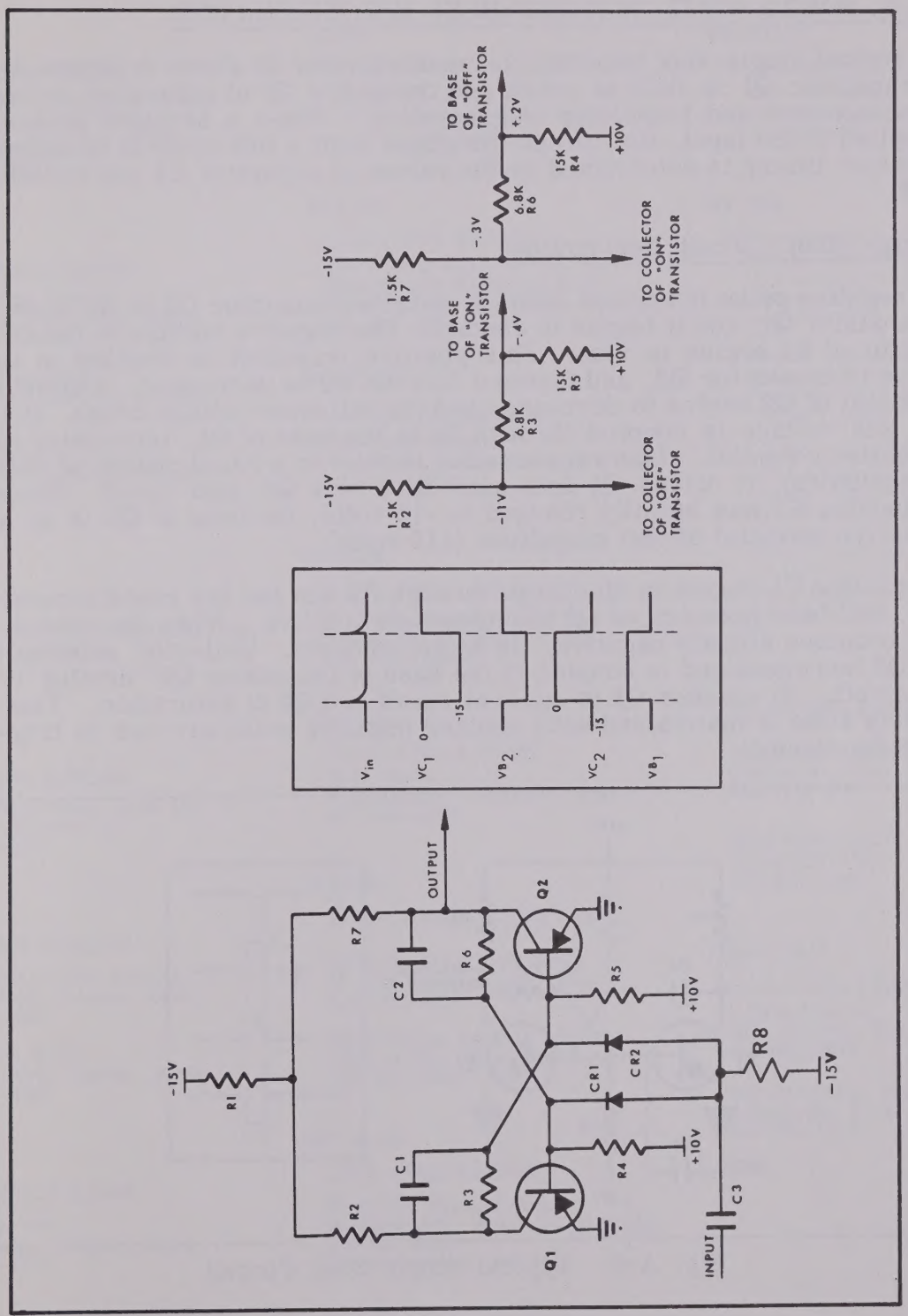


Fig. A-8A. Positive Pulse Steering

A.9 SINGLE-SHOT (MONOSTABLE) MULTIVIBRATOR

A typical single-shot (monostable) multivibrator is shown in figure A-9. Transistor Q1 is held at cutoff and transistor Q2 at saturation by bias arrangement and transistor regeneration. When a negative pulse is applied at the input, the circuit functions until a full cycle is complete. Circuit timing is determined by the values of capacitor C1 and resistor R2.

Single-Shot Circuit Description

A negative pulse is applied through coupling capacitor C2 to the base of transistor Q1, and it begins to conduct. The negative voltage at the collector of Q1 begins to rise. This positive transient is coupled to the base of transistor Q2, and forward bias on Q2 is decreased. Collector current of Q2 begins to decrease, and its collector voltage drops. Part of this voltage is coupled through R4 to the base of Q1, increasing its negative potential. This regeneration results in a rapid change of both transistors; it drives Q1 into saturation and Q2 into cutoff. Since capacitor C1 was initially charged to -15 volts, the base of Q2 is at a positive potential of that magnitude (+15 volts).

Capacitor C1 begins to discharge through R2 and the low resistance of Q1, and base potential of Q2 becomes less positive. When the base of Q2 becomes slightly negative, Q2 again conducts. Collector potential of Q2 increases and is coupled to the base of transistor Q1, driving it to cutoff. Transistor Q1 is again at cutoff and Q2 at saturation. This stable state is maintained until another negative pulse arrives to trigger the circuit.

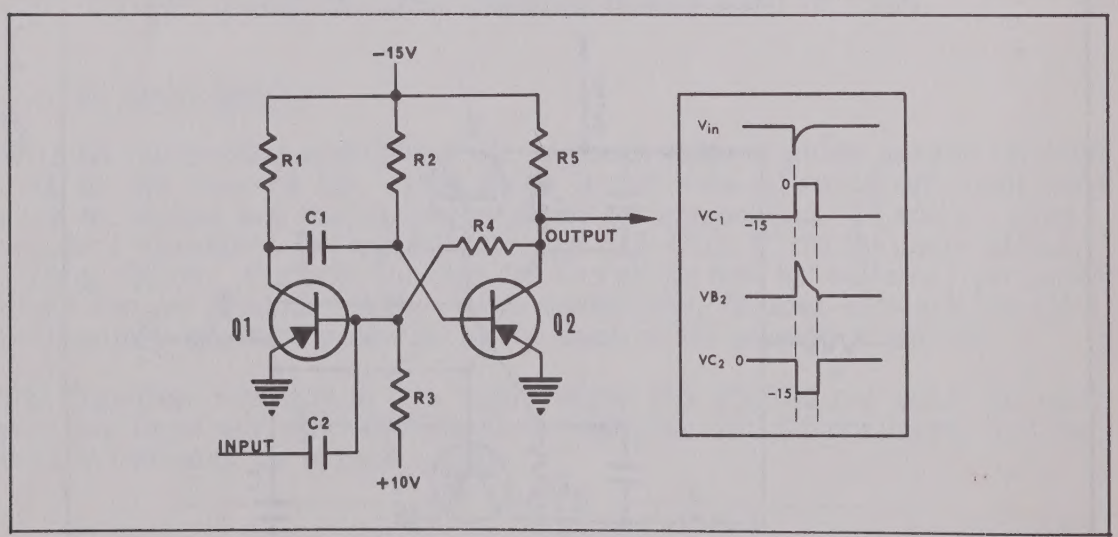


Fig. A-9. Typical Single-Shot Circuit

BECKMAN INSTRUMENTS, INC.

Electronic Instruments Division

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3313 Memorial Parkway, S.
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6016 Troost Avenue, Rm. 202
Kansas City, Missouri 64110
314-371-5900

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E.I.D. Sales & Service

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Mountainside, New Jersey 07092
201-232-7600
(Factory Repair Facility)

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Representative:

Price-Parrish
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Albuquerque, New Mexico 87112

NEW YORK

Representative:

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119 Luther Avenue
Liverpool, New York 13088
315-474-7481

NACO Electronics Corp.
99 Harvest Road
Fairport, New York 14450
716-573-4169

NACO Electronics Corp.
2631 Edgewood Road
Utica, New York 13501
315-732-1801

NACO Electronics Corp.
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Poughkeepsie, New York 12603
914-462-2730

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1422 Westmoor
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512-454-4465

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16 East Stratford Ave.
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WASHINGTON

E.I.D. Sales & Service

225 - 108th Avenue, N.E.
Suite 105
Bellevue, Washington 98004
206-454-9528

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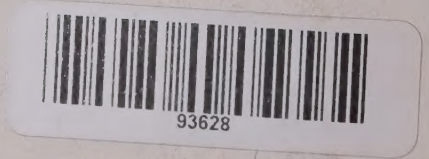
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